# SCIENCE

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## *THE UNIVERSITIES AND INVESTIGATION*[1]

As a representative of the university and as one but recently come to live among you, it is perhaps fitting that I should use the opportunity which President Hall has so kindly given me to discuss certain phases of university work in which many of my own chief interests lie, but which are not often brought before the attention of our public. I refer to the relations of the universities of the country to original investigation, and particularly to scientific investigation, since it is with a part of this—and necessarily in these days of specialization a small part—that I am personally concerned. Many of us in America have lived through a period in which the purposes and scope of the universities were at first not very clearly conceived; but as time has passed the situation has changed, and on the whole an agreement now prevails, which is likely to be permanent, regarding certain features of university policy which once were subjects of dispute. One of these is that investigation is an essential part of the work of every university. We now recognize that the universities have a double function to perform: one, that of disseminating liberal and scientific knowledge; the other, that of adding to it. There is nothing new in the idea that the chief concern of universities is liberal knowledge; *i. e.*, knowledge of a kind not directed primarily toward special or utilitarian or personal ends, but scientific or humane knowledge, relating especially to those matters which have a broad human significance and general applica-

[1] Founder's Day Address at Clark University.

bility. But in America it is only within the past twenty-five or thirty years that the universities have generally come to recognize it as their function to extend, as well as to maintain and transmit, such knowledge in all departments of learning. In a sense this is the more fundamental task of the two, since the attainment of scientific knowledge must precede its use in instruction or practical application; and it is perhaps the chief distinction of Clark University that it was one of the first to recognize and act on this principle. The day devoted to the memory of its founder seems thus an especially appropriate time for such a discussion.

Now investigation, in the scholarly or scientific sphere, means something more than the mere attempt to find something new. It means primarily all activity directed simply and solely toward the advancement of liberal knowledge—knowledge, that is, not of special or local or purely practical matters, but knowledge in its broader, more theoretical or purely humane aspects,—those which are concerned not so much with meeting the immediate occasion as with furnishing a generally valid basis of principles and methods that can be applied at will to all of the affairs of life. Breadth of application should be the main characteristic of this type of knowledge; it should meet not only the purposes of practical life, but also those of science and art, besides serving for the realization of the higher ideals of culture and conduct. The investigator knows that we can not assume all desirable knowledge of this kind to be already in existence and to be had for the asking; what we already possess has been gained chiefly by the prolonged and devoted efforts of previous investigators, working sometimes alone, sometimes in conjunction with others, and usually in universities or other institutions of learning; and we have to see to it that the task is carried on. That the task itself is a worthy one admits of no dispute; incalculable good has come to humanity through its means, and no doubt will continue to come if our efforts do not relax.

Why do so many seek knowledge without being seriously concerned about its application? This question is often asked, and its answer has puzzled many sincere persons. In various fields of science and culture we find men who seek knowledge with no other aim than to possess it. Is this aim worthy? Many, especially in these times, express doubts. Some even denounce such search as selfish. One hears such expressions as the selfishness of cultured persons. Yet those who do possess knowledge —worth calling by the name—are rarely troubled by such doubts. When Solomon rated wisdom as better than rubies, he no doubt expected that philosophers in general would agree with him, but not all other persons. Is it that a certain native endowment of intellect or temperament is required to take satisfaction in knowledge as knowledge, just as others delight in art as art? This is true in a measure, certainly; and the tendency has to be recognized and I believe encouraged. It is doubtful if an investigator or scholar in any field can be truly effective without this disinterested curiosity or simple desire to know; so that we must regard love of knowledge, even if it does not eventuate in action of any kind, as in itself desirable. Perhaps it is as well for it not to exist alone, but that is another question. There are, however, other and profounder—I might say biological—justifications for this tendency. Knowledge, in the biological interpretation, is the chief means of adjustment to the conditions of life. This is clear enough in practical life; if we *understand* a situation—have it clearly and accurately conceived in advance —we are better able to deal with it. The

same is true of even abstract or remote knowledge of the purely scholarly kind; it is *potential* means of adjustment; the cultured man knows how to adapt himself to most circumstances better than the uncultured man. Not only mankind, but all living organisms—both animals and plants—are so organized that their well-being depends on accurate adjustment to the conditions under which they live. The give and take of material and energy must balance; the term "adaptation" means simply the sum-total of the conditions that secure this balance. Now, for us men, the chief means of such adjustment is knowledge. Theoretical or abstract knowledge, the kind that investigators in pure science strive for, is merely that which is the most universally valid and applicable; it is therefore at bottom the most practical; so that if the chief aim of scientific investigation is the attainment of such knowledge, and even if the wish to attain it is often purely instinctive and unreasoned—as in fact it is in many of the best investigators—we can understand from the biological point of view why this should be so. Thus there is the best of sanctions for the knowledge-seeking tendency. Breadth of knowledge represents a surplus or reserve of potential activity,—whether it is actually called upon for use or not; and as such it is the most valuable possession that we can have, for it is the means by which purposes of any kind are rendered capable of realization.

Now let me define a little more fully what scientific men mean by investigation. Under this term come all efforts directed toward the one aim—the ascertainment of the clear, impersonal and objective truth concerning the matter in hand. Mankind has found no method that leads so certainly to the attainment of this end as the method of dispassionate, systematic and critical inquiry, using all available means impartially and thoroughly, and verifying all results once they are attained. In this sense scientific investigation is in no way different in its method from investigation in other fields, such as history, language or philosophy, or from the means which a good military commander or man of affairs adopts in familiarizing himself with a situation before he acts. In every case the aim is to ascertain impartially the actuality of the case, that which is *so,* quite independently of what our wishes or fears or other prepossessions may be. The means which we adopt may vary in different fields of investigation according to the nature of the matter under investigation; but the attitude of the true investigator is the same everywhere—an attitude of candid, critical, persistent and, above all, disinterested inquiry. It is important to realize the necessity for these qualities in the investigator, if true results are to be attained. Without them the purpose of investigation can not be realized; progress is slow, and results do not bear examination. Let me quote Faraday's conception of the natural philosopher—by which he means the investigator in natural science: "The philosopher," says Faraday, "should be a man willing to listen to every suggestion, but determined to judge for himself. He should not be biased by appearances; have no favorite hypotheses; be of no school and in doctrine have no master. He should not be a respecter of persons, but of things. If to these qualities be added industry, he may indeed hope to walk within the veil of the temple of nature." Here we have a statement, clear, simple and devoid of literary artifice, by one of the most fruitful scientific investigators of all times; and when we wonder at what has been accomplished by the science which has developed from beginnings largely made by him, we should remember that it is only by such men, working in such a spirit, that

the more fundamental truths can be brought to light. When, therefore, we say that we wish to encourage investigation, we really mean that we wish to encourage those who have the right spirit of investigation. Progress is due mainly to such men; and it is important in the interests of this progress that the universities, which devote so large a part of their resources to the work of investigation, should clearly recognize that the personal factor is still—as it was in Faraday's day—the all-essential. Knowledge, insight, and power of accomplishment are not in laboratories, libraries and organized institutions merely, but chiefly in those who put such means to their right uses.

It is needless, before an audience of this kind, to justify scientific investigation or to attempt to set forth something of what it has accomplished. I may, however, point out—since this has a bearing on much of what I wish to say later—one consideration which the world at large is prone to forget unless frequently reminded, namely, that it is the *fundamental* investigations which are chiefly important for science, and lay the foundations for those later applications affecting mankind generally. Thus in this sense we owe wireless telegraphy to Maxwell and Hertz rather than to Marconi, our freedom from many forms of disease to Pasteur, our mastery of the air to Langley and the others who studied the lifting power of moving planes; and many other similar examples could be given. In general we may say that if an adequate body of theoretical knowledge has once been gained, it is a relatively easy matter to make the desired practical applications. It is when there is no guiding theory and we have to work empirically that problems are difficult or impossible of solution. But if we know beforehand of any task that nothing but hard work and persistence is necessary for its accomplishment, we may say that there is no serious difficulty, for these qualities can be commanded at will in any civilized society. When, however, we lack the necessary knowledge of fundamentals, little or nothing can be done. I may here furnish an illustration from biological science. Until the relation of microorganisms to disease was discovered by Pasteur, physicians were almost helpless in many departments of medicine; but once this relation was established, means for indefinite advance were at once furnished; then, to use Ehrlich's phrase, "diligent empiricism" was all that was needed to master many problems of pathology; and, these once mastered, effective methods of diagnosis and treatment were forthcoming sooner or later. The relation of Faraday to electrical science is similar; and in the same sense engineering, scientific agriculture and mining, many valuable manufacturing industries, in short, all that is most characteristic in the material foundation of our civilization, could never have come into existence without the previous development of the pure sciences of physics, geology, chemistry and mathematics. Other and less tangible results are of equal importance, but it would lead too far to speak of these. I wish simply to make it clear that the fundamental knowledge must first be gained; and it is the task of the investigator to supply this knowledge. This he can do only by prolonged study, observation and experiment, directed toward the simple purpose of obtaining as full and clear insight as possible. In the pursuit of this aim problems inevitably arise that are both difficult and remote from popular interests; yet such problems must be solved, and it is largely for the purpose of providing opportunity and facilities for their solution that universities exist. This is why the greater part of research in pure science is necessarily conducted in the uni-

versities. On the other hand, experience has shown that those parts of scientific work which relate directly to useful applications can be carried on successfully under the pressure of general public demand; the material rewards of successful invention are a sufficient incentive to inventors. This, however, has never been true of investigation in fundamental fields of pure science, and it is difficult to see how it ever can be true. Such work itself is its own chief reward. Isolated men of genius may make great discoveries, as Boyle, Cavendish and Darwin have done in England; but in such cases fortunate circumstances and leisure are essential, and the number of such men is very small. For most investigators the opportunity of engaging in purely scientific or scholarly investigations is to be found only in the universities. The relation of universities to fundamental scientific progress is thus a peculiarly intimate one.

Advance in knowledge, as distinguished from the maintenance and application of existing knowledge, thus depends ultimately on the work of the investigator, and chiefly on the investigator in the university. If he is to accomplish his function he must direct his efforts to the practicable, under conditions that are favorable to his work—or at least not too unfavorable, for good will and talent can accomplish much in spite of adverse conditions. First, what is practicable? In his "Advancement of Learning" Bacon, the first advocate of systematic investigation, says:

> I take it those things are to be held possible which may be done by some person though not by every one, and which may be done by many, but not by any one, and which may be done in a succession of ages though not within the hourglass of one man's life; and which may be done by public designation though not by private endeavor.[2]

[2] I wish to express my indebtedness for this quotation to Dr. Mall's interesting article in the *Journal of the American Medical Association*, 1913, Vol. 60, p. 1599.

Bacon thus recognizes that many projects call for collective and coordinated endeavor, while others require individuals gifted with the necessary talents or opportunity. Collective action and individual action both play a part, and this is as true of the advance of science as of any other form of enterprise. Now it is a characteristic of our time and country that more stress seems to be laid on the importance of collective action or cooperation in scientific research, than on the importance of giving scope to the single investigator of original scientific genius. Whether this tendency is right or wrong I need not discuss just now. It is clear that cooperative research is essential for the solution of many scientific problems, especially those requiring the accumulation and coordination of large masses of data. Much of the work in statistics, heredity, astronomy, geology, sociology, and other sciences is of this nature; here are illustrated Bacon's classes of work "which may be done by many, but not by any one, or which may be done by public designation but not by private endeavor"; one has only to think of what is done by geological surveys, statistical associations, or scientific societies. Work which can not be done "within the hourglass of one man's life" may be well within the scope of an association; thus we have investigations relating to natural events which recur infrequently, like earthquakes or sunspot periods, or to processes which take place very slowly, like evolutionary changes in organisms, star movements, or other cosmic changes. Only the coordinated work of generations can throw light on such matters. Cooperative research thus plays an important part in the science of to-day, and there is a strong tendency on the part of many scientific men to insist on its all-sufficiency, and to regard the work of isolated or independent investigators as of minor consequence.

Bacon, however, mentions first of all the class of achievements that are possible to some one person, though not to every one. That in certain spheres of activity one person may be indefinitely superior to any other or even to any combination of others was familiar enough to Bacon, and social conditions were not then such as to obscure this truth or throw doubt upon it. Being a man of genius himself and an advocate of progress, he could not underrate the part which personal originality and power of invention play in progress; he knew that such qualities are of individual and not of social origin, although they naturally flourish best in a favorable social environment. It is perhaps time to protest against the tendency to undervalue detached investigators, which insists that every one shall work chiefly in cooperation with a group and for a collective aim. This tendency is undoubtedly strong at present, especially in America, because here the democratic spirit is more dominant than anywhere else and is subject to fewer corrective influences; and the resulting bias toward collectivism tends to lower the estimate placed on purely personal or individual qualities. Now reliance on "team-play" is well enough in its place; it plays an indispensable part in many undertakings. But such a spirit cannot be depended on to promote scientific progress by itself; in this sphere it is at best rather an accessory. The truth is that so far from progress depending on collective effort, the whole history of science shows that the guiding and fruitful ideas, those which form the seeds of later developments, nearly always originate in the minds of a few scattered thinkers or investigators, often working in isolation. Is there any reason to believe that this will not continue to be the case? Yet high scientific authority seems at times to encourage that belief. President Woodward, of the Carnegie Institution, in a recent address[3] warns his hearers against entertaining what he calls the subtle error that

> the more remarkable results of research are produced not by the better balanced minds, but by aberrant types of mind popularly designated by that word of ghostly if not ghastly implications, namely, genius.

Again he says:

> The more striking results of research, quite commonly in the past attributed to wizards and genii, and still so attributed by a majority perhaps of contemporary writers for the popular press, are now understood by the thoughtful to be the products rather of industry, sanity and prolonged labor than of any superhuman faculties.

Others extol cooperative research as the highest type of scientific work. But surely what is understood by scientific genius is not a wizard-like faculty of arriving at immediate and astonishing results, but rather that power of clear, imaginative and valid insight into phenomena which is the product of high native endowment combined with industry, sanity and prolonged labor. The peculiarities of pseudo-genius—which no doubt has besieged the Carnegie Institution for support from the beginning—should not be allowed to cast discredit on true genius, a totally different thing. When we understand clearly what scientific genius really is, we must recognize that it is no less indispensable to the production of the highest scientific work than is poetical genius to the production of the highest poetry. Every-day experience proves that industry, sanity and prolonged labor are not sufficient for the best work in any domain. It would be fortunate for humanity if it were so; for these qualities are not rare, and are in a measure attainable by all normal persons. Genius is not these—although when these are added genius may become more effective. Unfortunately—or perhaps fortunately—it evades rules; but it seems to

[3] SCIENCE, 1914, N. S., Vol. 40, p. 217.

include a strong instinctive element which appropriates or rejects the material which is presented to it—either by its own vivid imagination or by outside experience—according to the availability for the purposes that interest the genius. And this interest is likely to be absorbing to an extreme degree, and hence to arouse all the energies much more effectually than is usually possible to normal persons. But it is not necessary here to prejudge questions which are still a puzzle to psychologists. I wish merely to emphasize that whatever a final analysis may eventually show genius to be, there is no doubt of its existence, that it is rare, and that the chief achievements of mankind in science, as in art and literature, are due in the main to its activity. Only by recognizing these facts shall we be able to take properly into account all of the factors which contribute to scientific progress, and make due provision for all. If Darwin had been without means, there is no doubt that the most effectual way of promoting evolutionary science in his day would have been to provide him with an adequate personal endowment, or a university chair giving complete freedom for research. I emphasize this in order to bring to your attention the all-importance of the individual or personal factor in the work of scientific investigation. This consideration is a wholesome one for moderns to bear in mind; for the trust in cooperative methods, "team-play," and collective enterprise is so general, and has assumed such a dogmatic character, that it tends to deprive many persons—especially those whose talents are of a subtle rather than a robust order—of belief in their unaided personal powers, and hence to weaken their sense of personal responsibility. One result of this often is that they lose the normal and healthy compunction against laying up their talents in napkins.

Let us now return to our original subject. One of our aims in the universities is to further investigation. How are we to do this most effectually? The answer, in form at least, seems simple. First we must provide facilities, and second, we must have the right men. The first requirement is relatively easy; it is a question of material resources; the second is more difficult, as well as more important, for if it is impossible to make bricks without straw, it is still more certain that the best of straw will serve little for brick-making unless put into the right hands. But let us define a little more closely what we may regard as the conditions of successful research, with especial reference to the case of scientific departments in universities. In general three things are necessary; equipment, proper coordination of activities (or organization) and personnel. When these are combined in the right proportions we may hold that conditions are the most favorable; but this is not always possible, and usually some choice has to be made; which is the most important and fundamental? This question is not easy to answer; so much depends on what is under investigation; a completely and expensively equipped laboratory can undertake researches which are beyond the reach of one of more modest resources; and yet the difference in the importance of the results gained by the two may not be commensurate. Here we see the significance of the personal factor. Darwin will make important discoveries in his kitchen or back yard, while a costly laboratory, although making a great show of activity, may be comparatively fruitless in important results. This fact, however, does not make it any the less desirable that the apparatus for research should be at hand; but it indicates that if results are to come, such means should be used properly, and this can be done only by the right men. Appeals for

equipment have on the whole been well met in this country; and our relative lack of scientific productivity has little if any relation to lack of equipment. Nor is it for lack of numbers and organization that the universities fall short in scientific productivity. Everything that organization and system can do is done in our larger universities. Officers from the president down are numerous and minutely graded, hierarchy within hierarchy; there are departments and subdepartments; every subject is represented by one or more specialists; the courses given in a large department are numerous and detailed and cover all phases of the subject. The work of students is carefully supervised; so many credits go to the making of a master's, so many to a doctor's degree. No one is idle for a minute. The mere mechanism requires exacting care; the head of a department must often be primarily an executive; much of the time is given to duties of management; the telephone, the typewriter and the card-index are as much a part of his equipment as of the business magnate's. It would seem as if all of this machinery ought to be effective. Yet misgivings force their way in. There is reason to think that this faith in the efficacy of organization in university work is not derived from experience, but rather from a preconceived belief that methods which are so effective in practical life ought to be equally so in the intellectual life. But is this really so? Many of us have grave doubts. In our own private studies devotion to card-catalogues and notebooks can go too far, as many a man has found from bitter and paralyzing experience. Is it really true that the letter killeth, but the spirit giveth life? There must be conditions more important than equipment and organization—conditions which are somehow lacking. What are they and how can they be furnished?

It is for the universities to make the right answer to this question, and also to rectify the conditions. The majority of productive scholars and investigators are connected with universities. If the scientific productivity of the nation is less than it ought to be, as we see when we compare ourselves with Germany, France or England, we can only ascribe the deficiency to the presence of unsatisfactory conditions in the universities. What are these? and how are they to be removed?

Such a question carries very far and admits of no off-hand answer. The universities represent the intellectual tendencies of the country. They are, or ought to be, one of the chief sources of what is highest in its civilization. Why do fundamentally important contributions to science or scholarship come so infrequently? and is there any way of making them come more frequently? What man has done man can do: there must be some restricting and removable conditions which either prevent original investigators from doing their full quota of good work, or it may be prevent the creative type of scholar from finding his way into the universities in the numbers that we have a right to expect. What the chief of these conditions are, and how all those interested in the welfare of our institutions of learning can aid in their removal and replacement by better, is what I shall now try briefly to indicate. I ought perhaps to say that I offer my suggestions in a far from dogmatic spirit, being aware that the problem is highly complex, and that no one man can be fully familiar with all of its aspects.

When we look at our universities we are impressed with certain obvious peculiarities—their size, their wealth, the variety and complexity of their activities and of their organization. We may agree that size and wealth with the resources that they bring

are all very well—in themselves desirable—but complexity of organization, and the practises and tendencies that go with it? are these conducive to the intellectual life? This, in my opinion, is the critical question. So far from our taking this for granted, there is good reason to believe that beyond a certain limit dependence on system and organization in institutions of learning is directly injurious to good work, and this for the simple reason that it makes for the stereotyping of activities, and hence interferes with freedom and its expression, which is originality. Such restriction in fact is the general purpose of organization; it aims at diminishing variation from an accepted norm. Now the more stereotyped certain things are the better; thus a railway service or a department store can not be too regular and dependable; but if our aim is not simply to repeat things already done, but to discover new truth, the conditions that surround us, as well as our own temper of mind, should so far as possible encourage independent activity, and not simply that carried out in accordance with a program. In brief, purely routine activities should be subordinated in an institution of higher learning; all needless machinery should be disposed of, and the rest should be relegated to its proper place. This is a practical suggestion, and it is one of the first that I should make.

I do not, of course, wish to propose anything impracticable, and I am aware that a certain degree of established order, inseparable from organization of some kind, is necessary to stability and efficiency even in an institution devoted purely to research. But what I maintain is that the aim should be a minimum rather than a maximum of organization, and that the ideal toward which universities should work, if they regard original scholarship as something which it is their serious duty to further, is the attainment of the greatest possible freedom in the work of the individual departments and of the scholars making up those departments. A system of separate colleges, as in the English universities, or of autonomous departments, as in the German and some American universities, seems to give the best results. Such an ideal should not be left to chance, but it should be held consciously; and every one in the university should regard such freedom as the chief condition of his effective activity and should oppose vigorously every attempt to infringe upon it. Liberation must come from within rather than from without, and as the result of a more widespread insistence on the importance of personal freedom and initiative. This spirit would be incompatible with the over-developed autocracy that has aroused so much complaint. Freedom from merely petty and distracting activities would then soon come, and more men would give the best part of their attention to things that are seriously worth while.

The university should be the stronghold of individuality. Every one's serious interests should be respected and furthered so far as possible, both out of regard for personal freedom, and also because we do not know what their potential value may be. Remember that our aim as original scholars is not simply to impart what is already known and valued, but to produce something new, whose value to the world may not be in the least evident at first. But who can tell what its value may be later? Besides, it may be of value to the few if not to the many. We must recognize that the needs of men are as various as their characters and capabilities. A tolerance, open-mindedness, and detachment are thus of the essence of true academic life. An unwillingness to interfere needlessly, coupled with a determination to adhere by

high standards, may indeed be said to be the chief criterion of a high civilization.

There is reason to believe that the democratic movement of our time has in many ways been unfavorable to the development of strong individuality in the fields of science, literature and the arts. The collective spirit is now dominant, especially in America, and even in academic life many are unduly influenced by the desire of producing work which will make a direct appeal to the community at large, rather than work which is new and meritorious in itself, irrespective of whether it is popular or not. This spirit is inconsistent with disinterestedness, and hence tends to repress originality. It is hard to escape its influence; it constitutes an atmosphere—that element which is at once the most intangible and the most essential to life. We can however resist it if we only wish; and a spirit of independence or self-respect, that refuses to have its standards determined by anything short of firmly grounded personal conviction is the best safeguard. There is a sense in which too easy submission to the prejudices of a majority is like too easy submission to the dictates of a king or emperor. In either case the result is weakening to individuality, and hence to all work, like the work of scholarship, which demands independence and individuality.

We must remember that we are living in a time which tends to regard the collective welfare as the chief if not the only legitimate object of action. In one sense this is a great source of encouragement; it augurs well for the future of humanity at large; but it has its drawbacks. Little attention is paid, except by a few detached persons here and there, to the danger of having the whole national spirit dominated by the belief that nothing but work in the interest of large numbers is of any importance. Related to this is another very characteristic tendency. Where so many questions in politics and practical life are decided by counting of heads, a strong bias in favor of mere numbers is inevitable. Now there may be no disadvantage in this unless it becomes instinctive, *i. e.*, acted upon automatically and uncritically; but it is just this instinctive prejudice that prevails so strongly nowadays. All forms of activity share its influence; and it shows itself in educational institutions and universities in such phenomena as an over-insistence on the importance of large enrolments, the conferring of too numerous degrees, and a distinct and widespread tendency to leniency in the standards of quality. Public opinion in a democracy favors these manifestations, and an institution dependent on public opinion for its support can not afford to be too unsympathetic toward them. But a danger lies here, which is perhaps the more insidious since it can be recognized and guarded against by comparatively few. If we work only in the interest of and at the bid of majorities, we are in grave danger of disregarding the claims of the minorities. And this means undervaluing those types of person who are necessarily always in the minority, *i. e.*, exceptional persons of all kinds. The curious result follows that in a democracy, the political system which is theoretically the most favorable to liberty, the individual, regarded as an individual—and not as representative of a group (whose numbers may entitle it to respect)—often meets with little consideration. In other words, too much respect for collectivism tends to impair the respect which is due the individual, and personal liberty suffers. There arises a tendency to treat all persons in the mass, undiscriminatingly; and necessary distinctions fail to be made. Complaints of the low estimate which the democracies of England, France and America place on even the best and most gifted in-

dividuals have been appearing somewhat frequently of late; Faguet even says that the equalitarianism of the time leads to a distrust of all but mediocre persons in every capacity, and indeed favors a cult of incompetence; and he ascribes much of the inefficiency and shiftlessness of democracies to this tendency. This may be partly overstatement for purposes of emphasis; but it is at least clear that if the universities are to do their best work they should be consciously on their guard against such tendencies. We must remember that in a sense the statement that all men are equal is a dogma adopted primarily for political purposes; as such it embodies an important principle, and it serves to simplify the technique of representative government; but it was never meant to controvert plain facts. In any case we must avoid being influenced by it to the extent of disregarding talent and failing to do our best to single it out and develop it. Real progress can come only in this way. This policy, however, seems to be unpopular at present, and as a rule is little acted on in our universities. Thus the attempt to make a definite distinction between "honor" men and "pass" men—a distinction corresponding on the whole to that between those who seriously wish to study a subject and those who have no particular interest in it—is opposed as undemocratic. One often gains the impression that talented students do not try their best, because they have a feeling that it is not quite considerate or democratic for one man to prove himself the intellectual superior of another. Why this should be so is one of the mysteries; there is no such feeling about games like tennis. It may be that it represents a defensive reaction in the biological sense; it is said that white sparrows are badly treated by normal birds; and no doubt many persons feel safer when they identify themselves with a group than when they stand alone. The spirit of hostility to distinction is, however, peculiarly out of place in universities. It is difficult to judge our own community and our own time; we are subject to the fallacy of nearness; but there is little doubt that a general desire to regulate the activities of the individual in the supposed interest of the group is at present one of the most characteristic manifestations of the time-spirit, and that a submission to this desire by persons who think it democratic so to submit is responsible for a certain lack of distinction and originality in the intellectual activities of the day. The way in which organizations and societies flourish is a symptom of this; the remark has recently been made that whenever two or three are gathered together nowadays some one else is sure to be on his way to organize them; and this propensity encourages the individual in a kind of fatalistic belief that he can accomplish nothing working alone. Under these conditions, if he fails, he is often inclined to cast the blame on the organization to which he belongs or on the community rather than on himself.

It is essential that we should continue to regard the university as a place where individual talents of the most special kind will receive encouragement and development, as a place of preparation for leadership, and equally for the discouragement of any inclination to lean unduly on the rest of the community. The university man should be able to think for himself and by himself. No one can say what the potentiality of any one may be; if, therefore, a student is conscious that he has any special bent or enthusiasm for any subject, he should not hesitate to give his chief energies to its cultivation. It may be that he will meet with little sympathy from the outside world, or even from his intimates; but this should be no cause for discouragement. The univer-

sity exists largely to give opportunity to men of this kind. He must get over the feeling that it is necessary, or at least fitting, to apologize for the unpractical nature of his activities. The university is aware that many things can be done only by taking thought, just as others require immediate action without any particular thought. There is inevitably isolation and detachment in much of the work of universities; this is especially true of the work of investigation. Remember Wordsworth's lines on Newton's statue at Cambridge University:

> The marble index of a mind forever
> Wandering through strange fields of thought alone.

The withdrawal of such a man from the world is deliberate; only so can his purposes be achieved.

This withdrawal imprints a characteristic quality on academic life, with which it is often reproached. The very word academic is often popularly or journalistically used to signify remoteness from actuality. It might with equal justice be used as signifying *nearness* to actuality; but the fact is simply that the university recognizes as important or even pressing actualities many matters which to the world at large are virtually non-existent. The apparent ineffectuality of much academic work is a serious grievance to many people; and certain movements directed toward the radical modification of time-honored academic usages and privileges have arisen as the expression of this feeling; some persons, no doubt conscientious, have favored a system of supervision and time-keeping, with the object—laudable, no doubt, if only it were practicable—of making sure that the holders of university chairs do not waste their time. But it is just here that the uninitiated judgment is likely to lose its bearings; and we may well continue to repeat with the Sybil: "Procul este, profani!" Who is to be the judge in these matters? Who will guard the guardians? What constitutes effectuality in the intellectual sphere? We must refuse to be misguided by false criteria in these matters. What is most effectual in the activities of the scholar can not always be discerned even by his immediate associates. Nothing but the perfect witness of all-judging Jove would suffice for this. The true criteria are not evident to those ignorant of his work; and in forming an estimate of its value, confidence and respect for individuality have to be combined with the judgment passed by his peers in the learned world. If for lack of sympathy or special knowledge we fail to see the value of certain fields of scholarly work, there is nothing for it but to accept the assurances of those who know. Their judgment is likely to be critical enough, and not to err on the side of leniency. All plans of imposing upon the scholar rigid requirements from without—apart from the necessary responsibilities of teaching and contributing to his subject—are impracticable. I have mentioned certain recent attempts directed toward a closer external oversight of academic work; the authors of these attempts have urged that it would be well, in the interests of "efficiency," to estimate more closely the time which the occupants of university chairs devote daily to research, to teaching and to other activities. This is officialism run mad, you may say; but there the fact stands. Some one, well known as a defender of academic freedom, has remarked that the only really effective scientific mind works twenty-four hours a day. In saying this he may have had in mind Landor's passage:

> The capacious mind neither rises nor sinks, neither labors nor rests, in vain; even in those intervals when it loses the consciousness of its powers it acquires or recovers strength, as the body does by sleep.

If this is true, it is clear that all such attempts to enforce scientific productivity—usually under the delusion that it represents measurable and controllable "output" like the products of a factory—are futile, and overlook the essential requirements of all original work, which are simply opportunity, freedom from needless distraction, and the necessary leisure.

Regarding this last requirement a word or two is peculiarly apposite nowadays. Jesus, the son of Sirach, says: "The wisdom of a learned man cometh by opportunity of leisure"; and he goes on to explain that merely multifarious activities of the more obvious kind are injurious to such a man, since they hinder and distract him from more worthy tasks, and prevent his accomplishing what is truly worth while. For this, tranquillity is needed, and the depth that comes from prolonged and undisturbed concentration. This is an essential condition for the work of investigation; activity is useless unless properly directed; but direction requires thought; and thought requires time for thinking—which is leisure. Wordsworth says very profoundly in "Laodameia":

> . . . The Gods approve
> The depth and not the tumult of the soul.

I do not know of any more suitable motto for a university than just this. For, after all, it is depth we want; and no degree of external activity, however effective or apparently beneficial, can make up for its lack. But how can it be gained without leisure—freedom for thought and study and research, and belief in their efficacy and saving grace? Such freedom is the source of all spontaneity and originality. You all remember how, when an admirer expressed his delight over the perfection and inevitability of a line of Tennyson, and said he knew *that* was a pure stroke of inspiration, the poet replied: "Well, I smoked three pipes over that line." Now it may be that not all affairs can be conducted in that way; we in the universities should recognize this and not be disturbed by it, while maintaining, nevertheless, that our ways are different. We form a sanctuary for all those who, whether by smoking pipes or otherwise, can by the power of thought, and activity directed by thought, attain the essential truth in any matter. I do not speak here of the beautiful; that is the realm of art. But in scholarship what is essential is *ideas;* it is these which give value and interest to the often dry details of investigation, and which guide and inspire the work of gathering fresh detail. We find that if we have the ideas we can usually test their validity without great difficulty; but they are the indispensable, and we can not get them without thinking and studying deeply. For that we require leisure. I dwell on these considerations because there is little doubt that our day and generation does not sufficiently recognize the need of leisure in academic life, and often misunderstands its purpose. Yet it is essential that there should be an atmosphere of leisure—of freedom from external compulsion—in the universities, if they are to be fully and adequately productive in original scholarship. We must understand clearly the purpose of such leisure, which is simply to afford opportunity—not for idleness, as I need hardly say, but for fruitful independent effort. In this sense leisure should be the chief prerogative of the educated man everywhere. It really implies nothing but freedom, and for its proper use both discipline and high purpose are needed. The knowledge and the will to use freedom rightly—surely these are what all who are truly educated ought to have; and we must be willing first of all to assume that those who are entrusted with the tasks of education and the advancement of learning are

especially fit to be entrusted with their own freedom. It is likely that an enlightened society can be relied on to recognize this; but it is particularly the duty of the universities, if they believe in their own best traditions, to speak with no uncertain voice. We look chiefly to them for progress in those fundamental fields of knowledge which ultimately concern more intimately than any others the future of civilization; and if they are to continue their leadership they must show that they value above all immediate advantages the tradition of academic freedom.

RALPH S. LILLIE

CLARK UNIVERSITY,
February 1, 1914

## THE NATIONAL ACADEMY OF SCIENCES

THE Academy will hold its annual meeting at Washington on April 19, 20, 21, 1915. The program is as follows:

MONDAY, APRIL 19

10 A.M.—Business meeting of the Academy in the Oak Room of the Hotel Raleigh.

1 P.M.—Luncheon in the private dining-room of the Hotel Raleigh.

2.30 P.M.—Auditorium, National Museum. Public scientific session:

Thomas H. Morgan: "Localization of the Hereditary Material in Germ Cells." (30 minutes.)

Problems of Nutrition and Growth:

Jacques Loeb: "Stimulation of Growth." (30 minutes.)

Lafayette B. Mendel: "Specific Chemical Aspects of Growth." (30 minutes.)

Eugene F. Du Bois, medical director, Russell Sage Institute of Pathology (by invitation of the program committee): "Basal Metabolism during the Period of Growth." (30 minutes.)

I. S. Kleiner and S. J. Meltzer: "Retention in the Circulation of Injected Dextrose in Depancreatized Animals and the Effect of an Intravenous Injection of an Emulsion of Pancreas upon this Retention." (10 minutes.)

5 P.M.—Meeting of the editors of the *Proceedings*, Cosmos Club.

8 P.M.—Auditorium, National Museum.

First William Ellery Hale Lecture, by Thomas Chrowder Chamberlin, of the University of Chicago. Subject: "The Evolution of the Earth." (Illustrated.)

The lecture will be followed by a conversazione in the Art Gallery of the National Museum.

TUESDAY, APRIL 20

10 A.M.—Auditorium, National Museum. Public scientific session:

Joel Stebbins, Draper Medallist: "The Electrical Photometry of Stars." (30 minutes, illustrated.)

George E. Hale: "A Vortex Hypothesis of Sun Spots." (20 minutes, illustrated.)

Edwin B. Frost: "The Spectroscopic Binary, Mu Orionis." (10 minutes, illustrated.)

Robert W. Wood: "One-dimensional Gases and the Experimental Determination of the Law of Reflection for Gas Molecules." (10 minutes, illustrated.)

Robert W. Wood: "The Relation between Resonance and Absorption Spectra." (15 minutes, illustrated.)

Edward L. Nichols and H. L. Howes: "On the Polarized Fluorescence of Ammonio-Uranyl Chloride." (15 minutes, illustrated.)

Robert A. Millikan (by invitation of the Program Committee): "Atomism in Modern Physics." (30 minutes, illustrated.)

1 P.M.—Luncheon in the Oak Room of the Hotel Raleigh.

2.30 P.M.—Auditorium, National Museum. Public scientific session:

William Morris Davis: "Problems Associated with the Origin of Coral Reefs, suggested by a Shaler Memorial Study of the Reefs of Fiji, New Caledonia, Loyalty Islands, New Hebrides, Queensland and the Society Islands, in 1914." (60 minutes, illustrated.)

F. W. Clarke: "Inorganic Constituents of Marine Invertebrates." (15 minutes.)

Roy L. Moodie (introduced by Henry Fairfield Osborn): "Amphibia and Reptilia of the American Carboniferous." (15 minutes, illustrated.)

Henry Fairfield Osborn and J. Howard McGregor: "Human Races of the Old Stone Age of Europe, the Geologic Time of their Appearance, their Racial and Anatomical Characters." (15 minutes, illustrated.)

Charles A. Davis, geologist, Bureau of Mines (by invitation of the Program Committee): "On the Fossil Algæ of the Petroleum-yielding Shales of the Green River Formation." (15 minutes, illustrated.)

Nathaniel L. Britton: "The Forests of Porto Rico." (10 minutes.)

J. Walter Fewkes: "Pictures on Prehistoric Pottery from the Mimbres Valley in New Mexico, and their Relation to Those of Casas Grandes." (20 minutes, illustrated.)

Charles B. Davenport: "Inheritance of Temperament." (15 minutes.)

Charles B. Davenport: "Inheritance of Huntington's Chorea." (12 minutes.)

8 P.M.—Annual dinner of the members of the Academy and their guests and presentation of the Draper medal, held in the Oak Room of the Hotel Raleigh.

WEDNESDAY, APRIL 21

10 A.M.—Oak Room, Hotel Raleigh.

Business meeting of the Academy for the election of members and two members of the council.

1.30 P.M.—Luncheon in the private dining-room of the Hotel Raleigh.

2.45 P.M.—Auditorium, National Museum.

Public scientific session. George H. Parker, official representative of the academy upon the Special Commission appointed by the President of the United States to study and report upon the Alaskan fur seals during the summer of 1914. Subject: "The Fur-Seal Herd of the Pribilof Islands." (Illustrated.)

4 P.M.—Auditorium, National Museum.

Second William Ellery Hale Lecture, by Thomas Chrowder Chamberlin, of the University of Chicago. (Open to the public.) Subject: "The Evolution of the Earth." (Illustrated.)

JACQUES LOEB: *Stimulation of Growth.*

The speaker intends to discuss the stimuli which induce development and growth in three cases.

1. *Artificial parthenogenesis,* or the nature of conditions which cause the egg to develop. It has been shown that all substances which cause a cytolysis of the surface layer of the egg start the development; and that the spermatozoon must contain a substance of that character; but that in addition a second treatment is required to insure a more normal development. The alteration of the surface layer increases the rate of oxidations in the egg by 400 to 600 per cent. and the same effect is produced by the entrance of the spermatozoon into the egg.

It seems that under certain conditions this alteration of the surface is reversible and it is inferred but not yet proven that in this case the acceleration of the rate of oxidations is reversed. This reversibility is a fundamental fact, since the alteration of conditions of active growth and rest are a prerequisite for the continuity of life.

2. *Metamorphosis.* Phenomena of growth occur in the larval metamorphosis when certain organs disappear and new ones begin to grow. A number of facts have indicated that substances circulating in the blood are responsible for these phenomena of growth and this conclusion was put on a permanent basis by the discovery of Gudernatsch that it is possible to induce in tadpoles at any time the outgrowth of legs and complete metamorphosis by feeding them with thyroid.

3. *Regeneration.* By regeneration we mean the phenomena of growth started by the removal of some part. It can be shown that in these cases also the growth is induced by the collection of (probably specific) substances at places where they could not gather under normal conditions.

LAFAYETTE B. MENDEL: *Specific Chemical Aspects of Growth.*

A review of the methods employed in the investigation of chemical problems of growth. Analysis of the tissues of growing individuals has failed to contribute much of specific importance, owing to the tendency of the body to maintain a fixity of composition under varying conditions of diet. The study of nutrition in growth is more profitable. This has involved a determination of the constructive units essential for the building up of an adult organism. Recent contributions respecting the rôle of the individual nutrients, and particularly the proteins, are considered. The part played by the amino acids derived from proteins in digestion has been investigated. Some of these can be synthesized in the organisms; others apparently can not, and must be furnished in some form in the dietary. The newer researches suggest that in addition to the familiar foodstuffs certain as yet undetermined food accessories (also called "vitamines") are needed. The evidence for this view and the facts regarding the existence of special chemical determinants of growth are discussed.

EUGENE F. DU BOIS: *The Basal Metabolism during the Period of Growth.*

In order to compare the basal metabolism of children with that of adults it is best to use as a basis the calories per square meter of body surface per hour. The average figure for men is 34.7 calories with a plus or minus variation of 10 per cent. For a short time after birth the average for infants is 20 per cent. below this figure. The metabolism then rises rapidly and reaches a point 50 per cent. above the adult level at the age of 2 years, remaining at this height until the age of 6

years, then falling steadily until the age of 19. From this point there is very slight decrease before old age is reached. During convalescence from typhoid fever the curve of metabolism is similar to that of childhood. The evidence points towards an increased metabolism of growing tissue. The fact that the liver and thyroid gland are relatively large in children may account for part of the increase.

I. S. Kleiner and S. J. Meltzer: *Retention in the Circulation of Injected Dextrose in Depancreatized Animals and the Effect of an Intravenous Injection of an Emulsion of Pancreas upon this Retention.* Preliminary communication. Presented by S. J. Meltzer.

When dextrose is injected intravenously into normal animals, even in large quantities, it disappears rapidly from the circulation, and the sugar content of the blood is, in a short time, quite normal again. In previous investigations the authors found that in depancreatized dogs there is a tendency for the circulation to retain for a longer period a part of the injected dextrose. In recent experiments it was further found that, when with the infusion of dextrose in depancreatized dogs an emulsion of pancreas is simultaneously injected, the circulation seems to lose its power to retain the injected dextrose. These experiments seem, therefore, to show that the power of the circulation to rid itself of a surplus of sugar is due to the influence of an internal secretion of the pancreas.

R. A. Millikan: *Atomism in Modern Physics.*

Atomism in modern physics begins with Dalton's discovery in 1803 of exact multiple relationships between the combining powers of the elements. Out of this discovery grew the whole of modern chemistry. The second tremendously important step was taken in 1815 when Prout pointed out that the atomic weights of the lighter elements appeared to be exact multiples of that of hydrogen, thus suggesting that hydrogen was itself the primordial element. The periodic table of Mendeleef added support to such a point of view, and Mosley's recent brilliant discovery through the study of X-ray spectra of a new series of multiple relationships, represented by a consecutive series of atomic numbers from 13 up to 79 with every number except three corresponding to a known element, is another most significant bit of evidence. When we add to this three other facts, namely, (1) that each member of a radioactive family, like the uranium family, has been definitely shown to be produced from its immediate ancestor by the loss by that ancestor of one atom of helium (which is almost equal in weight to four atoms of hydrogen), (2) that in an atomic weight table the differences between the weights of adjacent elements are in almost every case exact multiples of the weight of the hydrogen atom, the characteristic helium difference 4 appearing with extraordinary frequency, and (3) the fact that the introduction of the concept of electro-magnetic mass, and the consequent discovery of the inconstancy of mass, open several ways of explaining the slight departures in the exactness of the multiple relations between atomic weights pointed out by Prout, it will be evident that modern science may well feel fairly confident that it has indeed found in hydrogen the primordial atom which enters into the structure of all the elements. All this is merely a very modern verification of very ancient points of view.

But modern physics has recently taken a more significant and more fundamental step than this, for it has looked inside the atom with the aid of X-rays and other ionizing agents, and has there come upon electrically charged bodies, whose inertia or mass is wholly accounted for, at least in the case of the negative elements, by their charges. This discovery marks the fusing into one another of two streams of physical investigation, namely, the molecular stream and the electrical stream. A necessary condition for the justification of this last step was the bringing forward of indubitable proof that the thing which has heretofore been called electricity is after all, contrary to Maxwell's view, a definite material substance in the sense that it exists in every charge in the form of discrete elements; in other words, that it too like matter is atomic or granular in structure. Such proof was found in the discovery in the oil drop experiments of even more exact multiple relationships between all the possible charges which can be put on a given body than Dalton had ever discovered between combining powers or Prout between atomic weights or Moseley between X-ray frequencies. The greatest common divisor of this series of charges is then the ultimate unit or atom of electricity which has been named the "electron." New evidence that it is indeed a universal and invariable natural constant will be brought forward and a new determination of its value will be presented.

It is obvious that as soon as we could assert that these electrons are found in the hydrogen atom it was necessary to suppose that a single hydrogen atom contains at least two such electrons, one positive and one negative, and as a matter of

fact the evidence is now strong that it consists of exactly two. This twentieth century has then discovered for the first time a new subatomic world of electrons, the constituents of atoms.

All this is definite and probably permanent. But atomic conceptions in more or less vague form have also begun to invade the one remaining field of physical investigation, namely, the field of ethereal radiations. The most significant of recently discovered facts in the domain of radiant energy are these:

(1) Ethereal radiations when absorbed by matter, if they are of high enough frequency, will detach one and only one electron from a single atom. (2) The energy transferred to this electron from the ether wave is independent of the intensity of the incident radiation. (3) It is also independent of the kind of matter from which the electron is taken, but (4) it is exactly proportional to the frequency of the ether wave which detaches it.

These facts are stated in an equation set up tentatively by Einstein in 1905, and arrived at by him from the standpoint of a modified corpuscular theory of radiation. New proofs of the exactness of Einstein's equation will be presented and the evidence for and against Einstein's conception will be discussed. Whether the conception ultimately stands or falls, it appears probable, at any rate, that an equation has been obtained which is to be of no less importance in future physics than Maxwell's equation of the electro-magnetic field, and which seems destined to unlock for the physicists of the future the doors to the understanding of the relations existing between matter and radiant energy.

W. M. Davis: *Problems Associated with the Origin of Coral Reefs suggested by a Shaler Memorial Study of the Reefs of the Fiji, New Caledonia, Loyalty Islands, New Hebrides, Queensland and the Society Islands.* (Illustrated.)

The sea-level coral reefs of the Pacific are singularly non-committal as to their origin. The visible reefs accommodate themselves indifferently to any one of the eight or nine theories invented for their explanation. Hence a choice among the theories must be guided not so much by a study of the reefs themselves as by a study of associated phenomena, which thus gain an unexpected importance in coral reef investigation. It is because the associated phenomena have been insufficiently studied that so many contradictory theories have found favor. Of all associated phenomena, those provided by the central islands within barrier reefs are the most accessible and the least equivocal; next in importance are those offered by uplifted and dissected reefs. It will be shown by means of landscape views and theoretical diagrams that no theory accounts for all the facts—those of the associated phenomena as well as those of sea-level reefs—so well as Darwin's original theory of subsidence; and that the strongest confirmation of Darwin's theory is given by the embayments of the central islands within barrier reefs, as was long ago pointed out by Dana. Thus the results now reached regarding the reefs of the Pacific agree with the conclusions announced in recent years by several Australasian observers. It is believed that the several alternative theories advocated by various investigators during the last thirty-five years will be given up, and that Darwin's theory of subsidence will regain the general acceptance that it formerly enjoyed (1840–80).

George E. Hale: *Some Vortex Experiments on the Motion of Sun-spots.*

A closely wound helix of brass wire, with circular disks threaded on it, is hung vertically in water and spun at high velocity. The columnar vortex thus formed gradually changes into a semicircular vortex ring, by the rise of the lower end of the helix until it meets the surface. Thus the second sun-spot in a typical bipolar group might be formed by the turning up of the columnar vortex assumed to constitute a single spot. Preliminary rotation of the whole mass of liquid retards or prevents the turning up process if in the same direction as that of the helix, and hastens it if in the opposite direction. Hence, a persistent single spot may represent a rotating gaseous column whose diameter is large in comparison with its length.

Circular or semicircular vortices have a proper motion at right angles to their planes, in the direction of motion of the inner edge of the whirling ring. As high and low latitude bipolar spots rotate in opposite directions, they should, therefore, move toward the pole and the equator, respectively. Carrington's observations show this to be the case. The velocity to be expected is being determined by measuring the velocity of vortex rings in liquids and compressed gases. Observations of the stream-lines of ionized smoke particles, above single and double magnetic vortices representing sun-spots, are also in progress.

F. W. Clarke: *The Inorganic Constituents of Marine Invertebrates.*

Essentially a report of progress. The object of the investigation is to determine, more systematically than has been done hitherto, just what each

group of organisms contributes to the marine sediments, and therefore to the formation of marine limestones and especially to their magnesian and phosphatic varieties. The work is practically complete as regards the true corals, the mollusks, the brachiopods and the echinoderms. The inorganic constituents of the corals and mollusks are mainly calcium carbonate, with insignificant impurities. The echinoderms are all more or less magnesian, their skeletons containing from 6 to 14 per cent. of magnesium carbonate. The brachiopods fall into two groups, the shells of one group being mainly calcium carbonate with little organic matter; while those of the other group are essentially calcium phosphate with much organic matter. Work is yet to be done on the foraminifera, the coralline hydrozoans, the bryozoans, sponges and crustaceans. Some of the results so far obtained are novel, others merely confirm the older recorded observations.

Charles A. Davis: *On the Fossil Algæ of the Petroleum-yielding Shales of the Green River Formation.*

The Green River shales of Eocene age are known from northwestern Colorado, west into Utah and north into Wyoming. In places they are more than 3,000 feet thick. They are usually hard, tough, compact and fine-grained and brown in color, but weather to light gray or whitish. Certain beds are highly carbonaceous, burn freely and appear like lignite. Freshly broken surfaces give off a bituminous odor but never appear oily; when heated in closed retorts, petroleum passes off among the distillates.

By special treatment this shale has been sectioned to any desired thinness with a microtome. Microscopic examination of such sections from samples yielding abundant petroleum on distillation, shows the shale to be composed largely of organic matter, chiefly of vegetable origin, as well-preserved plant remains are common.

The most conspicuous plants observed are microscopic algae, which are very numerous in the slides so far studied.

The discovery of a very considerable algal flora in this great and but slightly altered series of petroleum-yielding shales is of especial interest because of the light it may throw on the origin of petroleum and related compounds.

(A few lantern slides from microphotographs of fossil algæ from the shales will be shown.)

J. Walter Fewkes: *Pictures on Prehistoric Pottery from the Mimbres Valley in New Mexico, and their Relation to those of Casas Grandes.*

The unexpected discovery near Deming, New Mexico, of an exceptionally large number of vessels, made of earthenware, decorated with paintings of mythic animals and men, has led to an enlarged knowledge of the prehistoric culture of our southwest. These pictures, unknown a year ago, have been found in great abundance, and are highly characteristic. Those representing men engaged in various occupations are particularly valuable in the light they throw on ancient manners and customs.

These pictures were painted by a people antedating the nomads found in the Mimbres Valley by the first white visitors, and who disappeared before the beginning of the historic epoch. The pictures have archaic characteristics that point to a remote antiquity as compared to that on modern pueblo pottery.

The cause of the disappearance of this culture from the Mimbres Valley can be traced to local influences rather than to widespread modifications of climate. One of the important local causes of the abandonment of the prehistoric settlements when they were found, was a change in the course of the river.

The geographical isolation of the Mimbres Valley has played an important rôle in developing the peculiar culture these pictures express, while its north and south extension has facilitated interchanges of cultures leading to far-reaching resemblances in these directions.

C. B. Davenport: *Inheritance of Huntington's Chorea.*

Huntington's chorea is a name applied to a group of symptoms first brought together as an entity by Dr. George S. Huntington. The traits involved are four: (1) persistent tremors over a less or greater part of the body; (2) their onset in middle or late life; (3) their progressive nature, and (4) a progressive mental deterioration. Analysis of many chorea-bearing fraternities shows that this supposed neuropathic entity is really only a syndrome inasmuch as, in the choreic families, mental deterioration may appear without tremors, the tremors may progress without mental symptoms, the mental symptoms may not progress and the onset of the disease may be in early life. Indeed, an analysis of families reveals the presence of biotypes characterized by specific forms of choreic involvement and progression. In the inheritance of the elements of the syndrome the choreic movements are clearly a dominant trait; some of the elements of the mental condition (which is usually allied to manic-depressive insanity) are also dominant. The law of anticipation in successive generations

in the age of onset is shown probably to have a merely statistical significance.

C. B. Davenport: *Inheritance of Temperament.*

An analysis of matings between persons who have a prevailingly elated and those who have a prevailingly depressed temperament indicates that the temperament of the former is inherited as a simple dominant, that of the latter as a recessive, but not allelomorphic to elation. In $F_2$ and later generations the zygotic combinations are complex, including elated, depressed, alternating, normal and intermediate grades. Thus with a knowledge of ancestry sufficient to infer the gametic composition of the parents the distribution of temperaments for the offspring may, within limits, be predicted.

G. H. Parker: *The Fur-seal Herd of the Pribilof Islands.*

The Alaskan fur-seals are pelagic animals that, during the summer, come ashore on the Pribilof Island for the purpose of breeding. The adult males, or bulls, arrive on the islands in May and June followed by the females, or cows. A bull may have associated with him from one to over a hundred cows, and this assembly constitutes a harem. Each cow, shortly after her arrival, gives birth to one young seal, or pup, and soon thereafter becomes again pregnant. The period of gestation is a little less than a year. The seals in the main leave the islands for the open sea early in the autumn. In 1914 there were born on the Pribilof Island over 93,000 seals and the total herd was estimated to be slightly under 300,000, a fair increase over the former year. As there are about equal numbers of males and females born and as the average harem is composed of one male and about sixty females, there are under normal conditions a considerable number of excess males, the so-called idle bulls. The number of idle bulls is a measure of the lack of adaptation in the proportion of sexes and indicative of a certain inefficiency on the part of nature.

Arthur L. Day,
*Home Secretary*

Smithsonian Institution,
Washington, D. C.

## *EBERHARD FRAAS*

From Stuttgart comes the very sad news of the death upon March sixth of the very distinguished paleontologist, Dr. Eberhard Fraas, professor in the university and head of the Royal Museum of Natural History. On the very day following, namely, March 7, the widow of Professor Fraas learned of the death of their only son, Hans Oscar Fraas, in the Argonne near Vauqois, on March 1. The young man was twenty-two years of age.

Eberhard Fraas was one of the most talented pupils of Karl von Zittel, at Munich, and was one of the ablest and broadest of the vertebrate paleontologists of Europe. Besides his explorations, chiefly in the marine and terrestrial Trias and Upper Permian of Württemberg, he traveled widely through other parts of Europe, and made an extensive journey accompanied by the writer through the Jurassic-Cretaceous exposures of the Rocky Mountain region. It was, however, his journey to the dinosaur beds of German East Africa some years ago which very seriously impaired his health and necessitated one or two surgical operations from which he never fully recovered, so that although a man of superb physique his death came at the early age of fifty-two.

He leaves as his monument great collections of vertebrate fossils, especially in the museum at Stuttgart, including the phytosaurs and carnivorous dinosaurs of the Trias and many of the very early and most rare of the Testudinata besides a superb collection of ichthyosaurs from Holzmaden, which he was the first to describe, and of the marine Crocodilia from the Jura.

Among the most important of his early contributions were those to the Labyrinthodonts and other giant Stegocephalia of the Permian. Among his latest was the description of the carnivorous dinosaurs of the Trias as well as the geological narrative of the journey to East Africa. All his papers are enlivened by a keen appreciation of the importance of adaptation and of the adaptive significance of the various types of structure, one of his principal contributions in this line being his interpretation of the adaptive evolution of the ichthyosaurs from terrestrial to aquatic life, which was facilitated by the study of his unrivaled collections.

His death is a loss not only to the Fatherland but to the whole world of vertebrate pale-

ontology, for he was one of the most active and honored members of the new Society of Paleontologists which was recently formed in Germany.

His nature was most genial and those who had the privilege of journeying with him in the field will most keenly sorrow over his untimely death.

To the widow who is suffering this sudden and double bereavement all the friends and admirers of Eberhard Fraas in this country will extend their most heartfelt sympathy.

Henry Fairfield Osborn

American Museum of Natural History,
April 5, 1915

## THE ROCKEFELLER FOUNDATION AND GENERAL GORGAS[1]

The Rockefeller Foundation has invited General Gorgas to become a permanent member of its staff in the capacity of general adviser in matters relating to public sanitation and the control of epidemics. The trustees of the foundation have for some time been aware of General Gorgas's strong belief in the feasibility of completely eradicating yellow fever from the face of the earth.

During the two years of the foundation's existence the attention of the trustees has been chiefly given to problems of public health, including the control of epidemics and the need of a competent adviser and executive in this field has been strongly felt. When in cooperation with the American Red Cross the foundation undertook the important task of helping the Serbian government to control the epidemic of typhus and the threatened epidemic of cholera the trustees again naturally thought of General Gorgas as a man preeminently fit to be of service in this emergency, and at a meeting held in New York last week they decided to make him a definite offer. This offer is now taken under consideration, and he will doubtless communicate his decision within a few days.

The Foundation's invitation contemplates his retiring from active service, as he is now entitled to at any time, but it does not contemplate his resignation from the army unless he should be assigned to duties of such a nature as to be incompatible with the regulations affecting retired officers. Such a duty would be involved in his going to Serbia at the present time, which he could do as a representative of the Rockefeller Foundation, but not as an officer on the retired list of the army. The sanitary commission of the American Red Cross has actually been sent to Serbia in charge of Dr. Richard P. Strong, of the Harvard Medical School, as director. The Rockefeller Foundation is cooperating with the American Red Cross in the support of this expedition, and if General Gorgas should accept the Foundation's offer he will doubtless be largely influential in determining the nature and extent of its participation in the work.

In justice to General Gorgas, it should be stated that there is no foundation whatever for the statement that he is to receive a salary of $50,000. The offer of the Rockefeller Foundation includes a moderate salary and the assurance of the usual allowance in the event of resignation or death. If the offer proves attractive to General Gorgas it will be because of his sympathy with the general aims of the foundation in regard to public health and his belief that the resources placed at his disposal will enable him to render a large service to humanity along the lines of his professional experience and ambition.

[1] A statement made by Mr. Jerome D. Greene, secretary of the foundation.

## SCIENTIFIC NOTES AND NEWS

At the meeting of the American Philosophical Society, to be held at Philadelphia on April 22, 23 and 24, a long and important program of scientific papers will be presented. An account of the meeting, with abstracts of the papers, will be published in Science.

A testimonial banquet will be tendered Dr. Abraham Jacobi by the medical profession, his friends and admirers, under the auspices of the Bronx Hospital and Dispensary, on May 6, at the Hotel Astor, on the occasion of the eighty-fifth anniversary of his birth.

The honorary freedom of the Apothecaries' Company, London, has been conferred upon

Sir Ronald Ross, in recognition of the services rendered by him to medical science, especially in the prevention of tropical disease.

THE M. Salomonsen prize of about $200, awarded every fifth year at Copenhagen for some notable progress in the medical sciences, has this year been awarded to J. Fibiger for his work, "Animal-parasite Cancer in Rat Stomach."

AT the annual meeting of the Chemical Society, held on March 25, in London, the new officers elected were: *President,* Dr. Alexander Scott; *Vice-Presidents,* Professor F. R. Japp and Professor R. Threlfall; *Treasurer,* Dr. M. O. Forster; *Ordinary Members of Council,* Mr. D. L. Chapman, Professor F. G. Donnan, Mr. W. Macnab and Dr. J. F. Thorpe.

DR. EILHARD SCHULTZE, professor of zoology at Berlin, celebrated his seventy-fifth birthday on March 22.

PROFESSOR HIRSCHWALD, head of the department of geology and mineralogy in the Berlin Technical School, has been given the degree of doctor of engineering by the Technical School at Dantzig, on the occasion of his seventieth birthday.

REINHARD A. WETZEL, of the College of the City of New York, has been elected a member of the Deutsche Physikalische Gesellschaft, Berlin.

DR. CORNELIUS WILLIAMS, of St. Paul, has been appointed president of the newly established Minnesota State Health Bureau, and Dr. H. W. Hill, of Minneapolis, secretary.

THE Japanese government has applied to the Wistar Institute for the privilege of sending one of its medical officers to the institute to study neurology under Professor Donaldson.

DR. F. KØLPIN RAVN, professor of plant pathology at the Royal Landbohøjskolens, Copenhagen, Denmark, will come to this country during the first week in May and engage in a series of conferences with officials of the United States Department of Agriculture and of state experiment stations in the various states on problems concerned with cereal cultivation, particularly cereal diseases. He will be accompanied during his entire itinerary by one or more of the following men of the Office of Cereal Investigation: M. A. Carleton, C. E. Leighty, H. V. Harlan and H. B. Humphrey.

THE Royal Geographical Society's awards for 1915 have been made by the council and will be presented at the anniversary meeting on May 17. The Founder's Medal has been awarded to Sir Douglas Mawson for his conduct of the Australian Antarctic Expedition of 1911–14, which has achieved highly important results in several departments of science. The Patron's Medal has been awarded to Dr. Filippo de Filippi for his great expedition to the Karakoram and Eastern Turkestan in 1913–14. The Victoria Research Medal has been conferred upon Dr. Hugh Robert Mill, who for many years has done a great deal on behalf of geographical research. Other awards have been decided as follows: Murchison Award to Captain J. K. Davis, who commanded the S.Y. *Aurora* during the time of the Australian Antarctic Expedition, when he proved to be a seaman and commander of exceptional merit. Back Grant to Mr. C. W. Hobley, C.M.G., for his valuable contributions to the geology and ethnology of British East Africa. Cuthbert Peek Grant to Mr. A. Grant Ogilvie for the good work he has already done in geographical investigation and research. Gill Memorial to Colonel Hon. C. G. Bruce, M.V.O., who for 20 years has been exploring the Himalayas. The following resolution of the council has been accepted by the fellows of the society: "The council, having become aware that Sir Sven Hedin, a subject of a neutral state, has identified himself with the king's enemies by his actions and published statements, orders that his name be removed from the list of honorary corresponding members of the society."

DR. H. D. CURTIS, of the Lick Observatory, lectured before the faculty Science Association of Stanford University, on March 24, on "Some Recent Theories and Developments in Cosmogony."

PROFESSOR R. G. AITKEN, of the Lick Observatory, lectured before the Astronomical

Society of the Pacific in the Cabot Observatory, March 27, on "Globular Star Clusters."

Professor D. W. Johnson, of Columbia University, lectured on the "Physiography of Western Europe as a Factor in the War" before the Rochester Academy of Science on the evening of March 29; before a general convocation of the Case School of Applied Science in Cleveland on March 30; before a similar convocation of the students of Denison University at Granville on March 31; and before the annual meeting of the high school teachers of the state of Michigan at Ann Arbor on April 1.

The following lectures have been delivered under the auspices of the Syracuse University Chapter of Sigma Xi, during the second semester. On February 5, John A. Matthews, Ph.D., D.Sc., addressed a joint meeting of the Sigma Xi and the Archeological Society of Syracuse, on the subject of "Iron in Antiquity and To-day" and on March 5 Professor H. S. White, of Vassar College, addressed the chapter, students and public, taking as his subject "Mathematics in Nineteenth Century Science."

Dr. A. A. W. Hubrecht, professor of embryology at the University of Utrecht, died on March 21, in his sixty-fourth year.

## UNIVERSITY AND EDUCATIONAL NEWS

Princeton University has received from Mrs. William Church Osborn $125,000 to establish the Dodge professorship of medieval history, and $100,000 from an anonymous giver to endow a professorship of economics.

The Schools of Mines, Engineering and Chemistry of Columbia University have received an anonymous gift of $30,000, to be applied to the reconstruction and new equipment of the laboratories of quantitative, organic and engineering chemistry in Havemeyer Hall. A gift of $20,000 is announced from Mrs. Samuel W. Bridgham, daughter of the later William C. Schermerhorn, who was a trustee of Columbia University from 1860 to 1903. An anonymous gift of $4,000 has been made for surgical research in the College of Physicians and Surgeons.

Mr. George W. Brackenridge has given to the University of Texas his yacht *Navidad*, valued at $100,000, to be assigned to the biological department of the institution. A preliminary survey of the Texas coast is to be made in the *Navidad*, starting from Port Lavaca.

The trustees of Emory University, Atlanta, which is being developed under the auspices of the Methodist-Episcopal Church, have agreed to take over the Atlanta Medical College as its medical department. For this department it is proposed that $250,000 be set aside as an endowment. The trustees have also agreed to erect a new teaching hospital near the medical school, to cost from $300,000 to $350,000.

The University of South Dakota has just completed the erection of a fire-proof chemistry building at a cost of $100,000. Dr. Alfred N. Cook is head of the department.

The new buildings of the Washington University Medical School will be dedicated with suitable ceremonies on April 29 and 30. Among those who will deliver addresses are Dr. Eugene L. Opie, dean of the medical school; Dr. William H. Welch, of Johns Hopkins University; President A. L. Lowell, of Harvard University; Dr. William C. Gorgas, surgeon general, United States army; Dr. William T. Porter, Dr. R. J. Perry, Dr. George Dock, Dr. Abraham Flexner and President Henry S. Pritchett, of the Carnegie Foundation for the Advancement of Teaching.

Dr. George Harrison Shull, botanical investigator at the Carnegie Station for Experimental Evolution, has been appointed professor of botany and genetics at Princeton University. Steps will be taken immediately to develop gardens, greenhouses and laboratories for his work at Princeton.

Dr. Raymond G. Osburn, assistant professor of zoology in Barnard College, Columbia University, has resigned to accept the professorship of biology in the Connecticut College for Women.

Dr. B. F. McGrath has resigned as a member of the staff of the Mayo Clinic, Rochester, Minn., and has accepted the position of di-

rector of the laboratories of pathological and surgical research in Marquette University, Wisconsin.

DR. HAROLD B. MYERS, Portland, formerly connected with the University and Bellevue Hospital Medical College of New York City, has become professor of materia medica and pharmacology, and Dr. Howard D. Haskins, Cleveland, formerly connected with Western Reserve University School of Medicine, professor of physiologic chemistry at the University of Oregon.

DR. H. ROY DEAN, professor of pathology in the University of Sheffield since 1912, has been appointed to the chair of pathology and pathological anatomy in the University of Manchester.

## DISCUSSION AND CORRESPONDENCE

### BOTANY IN AGRICULTURAL COLLEGES

IN SCIENCE for February 5, 1915, Professor C. V. Piper, of the United States Department of Agriculture, calls attention to botany in agricultural colleges. The article referred to directs attention to the previous article by Dr. E. B. Copeland on the same subject in SCIENCE for September 18, 1914. It would seem to be especially true that "this opens up discussion of a many-sided question of high pedagogical importance to agriculture." The articles, referred to above, have presented valuable views and the discussion ought to be continued, perhaps by those more able to do so than the writer. The present is desired to be taken as discussion rather than argument, and certainly not adverse argument.

Dr. Copeland apparently emphasized that "the raising of crops is essentially nothing more or less than applied botany." Professor Piper has forcefully presented the idea that "in striking contrast with chemists, botanists have shrunk from what may be a major application of their science, namely, that of crop production." It would seem that these writers might be on common ground in the belief that the problem of crop production must of necessity be solved with the attention of botanists.

It is possible that the writer may call attention to some difficulties of administration that are bound to exist in agricultural colleges, so long as the boundary lines are not clear between botany and applied botany and possibly agricultural botany, on the one hand, and agronomy and horticulture on the other.

If it be true, as Dr. Copeland suggests, "the raising of crops is nothing more or less than applied botany," then there is small need for agronomy as a collegiate subject.

If it be true, as per Professor Piper, that the whole field of plant culture, or crop production, being one of plant ecology and plant physiology, must be so recognized by botanists, before progress in crop production will continue, then likewise the future of agronomy, at least the crop side of it, must necessarily trust to the mercy of the conservative botanist.

What is agronomy?

*Agronomy is the sum of information or of research directly concerning soils and crops grouped essentially in relation to the business of farming.*

Agronomy may be called a science where it is understood that a science is a group of related facts, or, again, it may be called an applied science where it is understood that it has use for many kinds of information which may be drawn from pure science. But any effort to define agronomy as a pure science or to accomplish the work of agronomy by conforming it to any given pure science must result in confusion or in begging the question of agronomy entirely.

It is a perfectly logical question to ask whether agricultural colleges need to recognize any such subject as agronomy. It is perfectly logical to inquire whether the purposes of such colleges may not be better accomplished without any departments of agronomy. It is conceivable that the work of agronomy in all agricultural colleges and experiment stations might be accomplished, or at least attempted, through the efforts of the several departments of pure science, which severally furnish sources of information from which agronomy must constantly draw.

The organization of agronomy as a group of facts in agricultural colleges is thus not absolutely necessary. It is no more absolutely necessary to organize departments of agron-

omy to conduct instruction and research about soils and crops than it was originally necessary to organize agricultural colleges to educate farmers. The organization of agronomy is arbitrary, just as the entire matter of organizing agricultural colleges was arbitrary. The essential reason why agricultural colleges were organized was that the American people through their Congress conceived the idea that such colleges, if organized, would more definitely solve the problems of farm people and other industrial people than the old forms of colleges already organized. In short, colleges of agriculture and mechanic arts were to be and are logically organized, upon the basis of industrial needs, or else there was not and is not any call for any such separate organizations whatsoever.

It is matter of fact that colleges of agriculture and mechanic arts were and are organized, at least after a fashion, in the several states. Some of them appreciated fully that older institutions were concerning themselves with pure science and had been doing so for a long time and, further, they themselves were not brought into existence to be so many more of the same kind, but rather to make a very direct attack upon the problems of the farm and other industrial life. Those that saw that problem most clearly, it is safe to say, made the best progress.

In such institutions grew and are growing such forms of departments as agronomy, animal husbandry, horticulture, home economics, and dairy husbandry. The unit of every one is an industry, not a science. The organization of every one was necessary to solve the problems of an industry, not essentially the problems of pure science. The people and the departments, for example, who will solve the problems of soils and crops are agronomists and departments of agronomy. They will attack the problems from the standpoint of the business of farming and not from the standpoint of making application of some particular kind of science. It is true that they will need all the accurate information they can acquire from all fundamental sources. Their future departments will embody men whose equipment of knowledge consists in facts necessary to the solving of their peculiar problems. Such equipment of knowledge as they will have may not make them able to compete with specialists in any given pure science within the field of that science, nor will they expect to. They will have a business of their own. Agronomy can not and does not disregard pure science, but it has not and does not waste much time discussing whether pure scientists need more training. If they do, it is supposed that they will know that much for themselves, and in due time get it. The devotees of pure science will be busy enough withal, looking after their own proper fields of information and research, whether they be botany, chemistry or mathematics.

It is the function of pure science or of the several pure sciences to increase the sum of knowledge. Pure science departments in agricultural colleges are not properly different in that respect from pure science departments anywhere else. If they teach as they must, they should mainly supply that common basis for scientific thought which must needs be the common equipment of all who may engage in any kind of scientific work. If they engage in research, they should continue to develop and enlarge the world's knowledge, with primary regard for knowledge, not its application. In the agricultural colleges, the departments specially organized for the purpose will undertake to make application. Specifically the agronomists of the country are as well prepared to look after this their business of application, as botanists generally are prepared to supply new knowledge.

As Professor Piper has correctly intimated, the business of raising crops has made much progress upon the basis of knowledge secured by agronomists. Strangely enough, some of this knowledge has been "empirical." The process will continue. The way for botanists and botany departments in agricultural colleges to help will be to devote themselves to botany, not agronomy. Perhaps if they do that they will occupy the most enviable positions in the pure science of botany, and bring corresponding honor to their institutions. This will not be possible for them if they fuss around with the business of agronomy.

By such concentration of effort, and by such alone, can the departments of botany in agricultural colleges put themselves in position to answer the demands for botanical knowledge that will be made upon them. By such attention to plants, not as crops and as a part of an industry, but as part of a wide world's life, can they properly supplement the practical knowledge of departments of agronomy. By working separately and together, each in its well-defined sphere, can departments of botany and departments of agronomy in agricultural colleges contribute to the people and to the industry of agriculture, such science and such practise as will entitle their institutions to an honored place in future collegiate life.

A. N. HUME

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SOME NOTES ON ALBINISM

THIS journal has recently[1] briefly recorded some observation of albinos which recall some chance observations of the writer.

In the late "eighties" or early "nineties" when the English sparrow first became common and abundant near Franklin, Indiana, the writer, as a boy, was much impressed by seeing a white English sparrow. The albino, as well as two or more partial albinos, was repeatedly seen during the latter part of one summer in a large flock of the birds which lived about the barn on the home farm. During the same or a subsequent season there occurred one or more of the partial albinos in a large flock of the sparrows on an adjoining farm. Three or four years ago a female English sparrow pied on one wing and a portion of the back was frequently observed at Cold Spring Harbor.

Within two or three years of the time when the albino English sparrows were seen in Indiana a white fox squirrel was frequently seen in the same neighborhood. The writer saw it only once momentarily and at some distance, but other members of the family saw it and a brother examined it after it was shot by a neighbor. It was white except for the tail, which was characteristically gray. The writer is under the impression that he was told that the eyes were "red," but can not vouch for that statement, although it is apparently a fairly safe inference that they were pink.

[1] O'Gara, January 1; Hargitt, February 12, 1915.

Near Oswego, Indiana (in 1903 or 1904), was seen an albino robin. It was not a clean white, but was tinged a slightly brownish or dirty hue. The bird was clearly seen at fairly close range and its identification could not have been mistaken.

In 1909 a family of gray squirrels, attracted by the abundant supplies of nuts, etc., proffered them, nested in a tree in the yard near a house in the edge of the town of Marietta, Ohio. One of the squirrels, the male, was a complete albino. Three of the young were albinos and one was a normally pigmented individual. The mother was accidentally killed and the young died. The following season an albino young one was captured and was kept in captivity until maturity. It was a pure albino with white hair and characteristic pink eyes. In all to the present time there are said to have been eleven albino squirrels known in that locality.

In 1907 while collecting the common aquatic isopod, *Asellus communis*, in a spring stream at Arlington, Mass., I found a number of pure albinos. The albinos were fairly abundant, there being perhaps one albino to eight or ten of the normally pigmented individuals. In January, 1910, and again in 1911 albino *Asellus* were found at the same spring.

In a small artificial pond in the Catskill Mountains last October the writer saw what he confidently believes to have been an albino newt, *Diemyctylus viridescens*. The animal was near the edge of the pool and escaped into deep water. It could not be located on subsequent visits to the pond, only a portion of whose margin was readily accessible for observation. The individual was pairing when seen and was apparently a female. There were many newts in the pond, on some of which the black pigment was not very conspicuous, but this one appeared so distinctly a clear uniform light orange yellow that its identification as an albino seemed fairly safe. It appeared very much to resemble in general body color an albinic or xanthic specimen of

the salamander, *Spelerpes bilineatus*, recently kept for several months at this laboratory.

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### ALBINISM IN THE ENGLISH SPARROW

THE notes on albinism in the English sparrow (*Passer domesticus*) appearing in SCIENCE of January 1 and February 12 suggest the desirability of placing on record certain similar observations made by the present writer. While residing in Chicago, from June, 1904, to May, 1908, I noted English sparrows showing partial albinism in the streets on many occasions. The extent of the white markings on these birds varied from a few feathers to perhaps a third or a fourth of the whole bird, no pure white individual being seen. The striking feature of the occurrence of these white marked birds was their abundance in the late summer and early fall of each year. At that season partial albinos were seen at least several times a week, sometimes daily for three or four days. By early spring these abnormal birds had disappeared; at any rate I have no notes regarding their observation at that time of the year. From these facts it would seem as though the numerous white-spotted birds seen in the fall were immatures of the previous summer. Also for some reason, perhaps connected with their conspicuous appearance, but few of them survived until the beginning of the following breeding season.

The common appearance of partial albinism in the English sparrow in a country where it has been recently introduced through human agency, as compared with the rarity of this phenomenon among most native birds, is suggestive of this being in some way an outcome of unusual conditions surrounding the species in its adopted home. In the absence of data regarding the sparrow in its native land, however, this is mere speculation.

Observations along the same line regarding another species of bird may have some significance. In southern California the Brewer blackbird (*Euphagus cyanocephalus*) has taken most kindly to the altered conditions brought about by settlement of the country, breeding in the shrubbery of parks and gardens, and feeding on the lawns throughout the towns. In Exposition Park, Los Angeles, the broad stretches of lawn have been particularly attractive to these grackles, and, especially in the fall, they gather here in large flocks. Partial albinism among these birds, just as with the English sparrows seen about Chicago, is of common occurrence in the late summer and fall, on several occasions two or even three white-spotted birds being in sight at the same time. The white areas of the birds observed were always of small size. None of these abnormal individuals has been noted in the spring. The question again suggests itself as to whether these grackles are not affected by something in the altered environment, the changed conditions having been obviously most favorable to the species and conducive to great increase in numbers.

In this connection, however, it is interesting to note that still another bird, the house finch (*Carpodacus mexicanus frontalis*), which has so adapted itself to urban conditions as practically to occupy in the towns of the southwest the position held elsewhere by the English sparrow, in all its vastly increased numbers shows no tendency toward albinism, at any rate no more than any other native bird.

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TO THE EDITOR OF SCIENCE: On page 26 of the current volume of SCIENCE Mr. P. J. O'Gara asks for information regarding albinism among English sparrows. I have frequently seen nearly white specimens, especially in New York City, but never any that were entirely white. I believe that albinism occurs more frequently in this species than in any other, because the natural enemies that pick off the conspicuous individuals of other species do not dare to molest the sparrows in their close proximity to man. Thus individuals with albinistic tendencies are enabled to breed and these tendencies are transmitted to their offspring. MAUNSELL SCHIEFFELIN CROSBY

TO THE EDITOR OF SCIENCE: In the issue of SCIENCE for January 1, there is a note by P. J. O'Gara on albinism in the English sparrow. As he asks for further observations I may say that I do not believe partial albinism is at all rare in the English sparrow. Although I have not recently observed any in this part of the country, some years ago, when living in Oregon, I used frequently to see English sparrows that were partial albinos associating with normal members of the same species.

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WITH reference to Dr. O'Gara's note on the above subject in your issue of January 1, 1915, I may state that in England it is of comparatively common occurrence. Cases are frequently reported in the *Field* newspaper, and I have known of three examples myself. Partially white birds are by no means rare.

I also possess a specimen procured by my brother at Mosul in Asia Minor.

G. BATHURST HONY

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TO THE EDITOR OF SCIENCE: In your issue of January 1, Dr. P. J. O'Gara, of Salt Lake City, Utah, states that on several occasions last summer he saw a single female English sparrow (*Passer domesticus*) in the busy streets of Salt Lake City with a pure white plumage. He had never seen any reference to albinism in the English sparrow, and he asks if other observers have found this character to be common in that bird.

In reply, I may say that albino sparrows are fairly frequently seen in different parts of New Zealand. I have about 600 correspondents in the domain who send me notes on natural history, and I have received from them about a score of albino sparrows. These birds were first introduced into New Zealand in 1867, and now are the worst of all the bird pests. Albinism also is not unusual in the English blackbird (*Turdus merula*) in New Zealand; several complete albinos have been reported to me.

It is interesting to note that our native birds show a very marked tendency towards albinism. There are few species of native birds that do not show this tendency. It is very noticeable in the Kiwi (*Apteryx*), whose soft, fluffy plumage, when pure white, is surpassingly beautiful. Our native birds also have a tendency towards melanism, but this is not so marked as the albinistic characteristic.

JAS. DRUMMOND

CHRISTCHURCH, N. Z.

## QUOTATIONS

### AN ATTACK ON THE HEALTH LAW OF NEW YORK STATE

LAST week we commented briefly upon the first annual report of the New York State Public Health Council, congratulating our fellow citizens upon the results of the council's activities and upon the framing of a new sanitary code for the state. And even as we were penning the lines several bills were being introduced into the state legislature which, if adopted, would seriously cripple the work of the commissioner of health and nullify the new sanitary code.

These bills, fathered by Assemblyman Hinman of Albany, five in number, are in the shape of amendments to the public health law. The first (Int. 1561) is directed against the commissioner of health and instead of the present injunction that he "shall not engage in any occupation which would conflict with the performance of his official duties," orders that he "shall devote his entire time to the duties of his office." This is perhaps the least objectionable of the proposed amendments, apart from the insulting innuendo concealed in it, for the duties of the commissioner of health are so exacting as practically to demand his entire time in any case. The second bill (Int. 1600) will, if it becomes a law, seriously interfere with the sanitary work in the state, for it reduces the number of sanitary districts from a minimum of twenty to a maximum of ten, and at the same time fixes the salary of the sanitary supervisor of each district at a maximum of $2,500. In other words, it doubles

the labors of the sanitary supervisor and reduces his salary about 20 per cent. The third amendment (Int. 1601) makes permissive, instead of mandatory, the establishment of divisions in the State Department of Health and gives the commissioner the power to increase or decrease the number of these divisions, to consolidate them, or to change the name of any division at his pleasure. This is an altogether unnecessary interference with the existing law, and if it had any effect it would be in the line of decreased efficiency as making the divisions impermanent and liable to change at the whim of any one in power for the time being. The fourth amendment (Int. 1602) strips the Public Health Council of its power to define the qualifications of directors of divisions, sanitary supervisors, local health officers, and public health nurses hereafter appointed. The introducer's object in this amendment is not apparent, but the result of its enactment would inevitably be to open these appointments to unqualified persons and to create a number of jobs to be given in reward for political services. The fifth and worst of this series of bad bills (Int. 1603) would deprive the Public Health Council of the power to establish sanitary regulations, would delegate this to the legislature, and would even abolish the present sanitary code unless it shall be approved by the present legislature—and how much chance it would have of being approved by a legislature which had already adopted these amendments one can well imagine.

These, briefly stated, are the bills by the enactment of which it is proposed to impair the efficiency of the health department and to vitiate the work it has already accomplished. What may be the reason for the introduction of these bills it is difficult to understand. Their passage would not be in the interests of economy, for the worst of them, if passed, would not save the state a dollar, and others would rather increase the expenses of health administration by reducing the efficiency of the department, by putting the formulation of a new code in the hands of inexperts and of men ignorant of sanitary science, and by opening many of the most responsible positions to incompetents. No business can save money in that way. The entire appropriation asked for by the health department is only about $400,000—a paltry sum in comparison with the saving of lives and of dollars as well, which it is certain will result if the present law is let alone.

As a direct result of the work of the department during the past year there are two thousand persons, one thousand of them children, alive to-day in this state, outside of New York City, who would have been in their graves but for the efforts of Dr. Biggs and the Health Council. Are Mr. Hinman and his colleagues in the legislature willing to let these and three or four thousand others (for the life saving in public health work is cumulative) die next year in order to save thirty-five thousand dollars in the salaries of the sanitary supervisors who are to be dropped?

We can not believe the legislature will pass these reactionary amendments or, if it does, that the governor will sign them. But it will be better to spare both the legislature and the governor trouble by killing the bills in committee. This would doubtless be their fate if every physician would at once file his protest with the chairmen of the committees which now have the bills under consideration. In such protest the bills should be referred to by their introductory numbers and the protest should be addressed to the chairman of the respective committee as follows: Introduction Number 1561 (the first one above mentioned), Judiciary Committee, Assemblyman Frank B. Thorn, chairman; Int. 1600, Ways and Means Committee, Assemblyman Alexander Macdonald, chairman; Int. 1601, 1602 and 1603, Public Health Committee, Assemblyman Gilbert T. Seelye, chairman. We need not add that prompt action is needed to save the state from this threatened calamity.—*New York Medical Record.*

## SCIENTIFIC BOOKS

*Biology.* By Gary N. Calkins, professor of protozoology in Columbia University. New York, Henry Holt & Co. 1914. Pp. i–viii + 241. 101 figures.

This text-book is frankly based upon the well-known earlier work of Sedgwick and Wilson and follows it closely in subject-matter, method and illustrations. It is, however, even more strictly of the informational type and omits all reference to practical exercises or laboratory directions. The physiological side of the subject is emphasized. In the order of treatment the present work departs from the plan of its prototype and substitutes the logical course of proceeding from the simple forms to the complex, for the more practical one of introducing the student to the subject through contact with an organism of such size that it can be studied by the ordinary method of observation. For most teachers this would seem to be a change of doubtful expediency. While the fern and earthworm are still considered at some length, other types (*Ameba* and other Protozoa, *Hydra, Homarus*) receive as much attention. In each case, however, the particular form is studied in connection with some biological principle which it illustrates. The amoeba typifies the activities of one-celled animals; hydra, the nature of animals with tissues; the earthworm, the conditions developing where organ systems are present; the lobster, a more complex condition of organ systems involving the subject of homology. More briefly the nature of one-celled plants is treated in connection with yeast and bacteria; parasitism, as exhibited by *Tænia,* is discussed; and animal associations, adaptations against parasites, and the mechanism of immunity are appropriately presented. A series of these general subjects, including animal descent, evolution, conformity to type, somatic and germ plasm, and Mendelism, appears in the last chapter of the book, wherein the most recent work receives attention.

General biology is defined by the author as the science which deals with "the fundamental principles of living matter" and he then outlines specifically seven subdivisions which embrace practically the entire realms of morphology and physiology. That the recognition of such a subject as general biology is purely a matter of expediency is admitted when the author states that a thorough study of any one of the seven topics would compass the whole field. The purpose of general biology is, however, conceived to be that of forming a foundation upon which the other more specific subjects can be built. It is the thought of the author, and of others who write similar books, that students can be made acquainted with the main biological conceptions through a course designed for this specific purpose instead of acquiring the knowledge as a result of personal experience with many animals and plants. The large results of biological research are presented to the beginner before he is much acquainted with the varied materials manifesting the properties of living matter.

Whether this method is the best for use with an elementary class in the freshman or sophomore year of a college course is open to question. Much depends upon the circumstances in each institution. It may be said, in a general way, that the observational sciences won a place for themselves in the curriculum because they promised a training, through personal experience, that could not be obtained in subjects which are studied merely from books. Information comes thus as a result of discovery, and with knowledge comes training. Not only are facts gained but the method of their acquisition appears through repeated experience with concrete examples. The student is not told that the lobster has twenty somites in its body, but he is asked to discover for himself the number present in a certain specimen. He is not offered the generalization that all normal lobsters have the same number, but he is led to form this conclusion himself through opportunities for comparison with other representatives of the species and by means of the collective experiences of his fellow students. He is not told that there is a large group of branchiate arthropods characterized by this fundamental organization, but he is guided to the formation of such a conception by the observation that a considerable number of such animals, although differing in many other ways, presents a repetition of the same numerical condition. Experience, not authority, is the guide; the goal is a development of the power of accurate observation and the formation of judgments based upon such observations, not the acquisition of cer-

tain facts relating to a group of objects, known as plants and animals, as distinguished from other facts relating to non-living objects, or from still other facts concerning human activities in methods of expression or of living. The path of each student in his approach to this goal is his own, and it varies in infinite degrees from all others—no beaten track of conformity to text assures his arrival.

"But hold!" says the efficiency expert of the curriculum makers, "Will the student learn all about plants and animals in *the* course in biology, will he be able to identify and name those forms he comes in contact with, will he know about the nature of his own body and of his relation to other animals? We want the student thoroughly grounded in the principles of biology, so make a book and teach him these things. For this purpose you may have him for one twenty-fifth of his college course." And so there is much writing of books and the puzzled teacher tries first one and then the other. Something is the matter with each one, so finally he makes a book of his own. If he has decided that the efficiency expert of the curriculum makers *is* right and that a certain group of facts, presented to the students for their acceptance or rejection is the proper content of a course he emerges from his trials very comfortably and, educationally, lives happily ever after.

Of the numerous efforts to supply the demand for text-books which shall inform students regarding the principles of biology, that of Calkins is one of the most satisfactory. Doubtless, in his own laboratory, the book occupies a proper place in relation to the individual work of the student; but it probably would not be far from the truth to assume that, even under these favorable conditions, the element of individual effort is small. In the hands of the dependent teacher even this remnant would disappear. When a descriptive text is used it results, under the best conditions of laboratory work, in confirmation by the student of facts studied in the book; in the absence of proper laboratory opportunities the course based upon it becomes merely another informational subject and the test of its accomplishment purely one of memory. The distinction between the observational sciences and languages, history and other subjects presented on the basis of authority, largely disappears in the former alternative and entirely so in the latter. Undoubtedly the subject-matter of biology would well warrant its inclusion in a college course, but in the face of the opportunities for training students in making accurate observations, forming independent judgments and developing logical habits of thought—qualities that are always so much needed—how poor is the return! It is not to be denied that it is easier to inform students than it is to train them; it is not to be denied that there is a large popular demand that schools should instruct their students upon matters which will be of immediate "practical" use to them later. But it is the duty of schools to recognize that real education is training, and so to devise and administer their curricula as to provide this training, to the best advantage, for the various types of mind that are to be educated. In furthering this purpose the subject of biology offers unique and valuable opportunities to develop the powers of observation, comparison and judgment through personal experience with the scientific method. In view of the great significance of this method in our past achievements, and of its promise for the future betterment of society, it is encumbent upon teachers of those subjects, in which it is best emphasized, to insist that they be given time and opportunity to teach in ways calculated to render effective, to the largest degree, its operation in the activities of their students.

C. E. McClung

*An Introduction to the Study of Fossils (Plants and Animals).* By Hervey Woodburn Shimer. New York, The Macmillan Co. 1914.

In most sciences it is a remarkable year which does not produce at least one text-book, but paleontology has been taught in this country for eighty years before the appearance of this, the first strictly American elementary text-book of paleontology. Amos Eaton seems to have been the first American teacher to

present this subject to students, and, as a teacher, is only the grandfather or great-grandfather of the present generation, for James Hall was his pupil, and it is well known how many owe their training directly or indirectly to him. It is probable that few of the American paleontologists, excepting those who have graduated since 1900, received any formal instruction in paleontology, the general method being to set before the pupil a tray of fossils and the "Paleontology of New York," and await the, sometimes tardy, results of self-development. This meant, of course, a very long period of training, and the consequent discouragement of many who might otherwise have pursued the subject. This somewhat haphazard method was due, I believe, largely to the absence of any suitable text-book. These remarks do not, of course, refer to the vertebrate paleontologists who have in the main been zoologists, and who trace a very different and by no means parallel line of descent.

English text-books have been available and used to some extent. First Nicholson (1872, then at Toronto), later Nicholson and Lydecker (1889) were used, but these books were too compendious for introductory work, and have now long been out of date. Next came Wood's excellent little book (1893), now in its fourth edition, but this text covered only invertebrate paleontology and is much better adapted for the use of students in England than those in America. Finally came the English revision of Zittel's text-book (1900, 2d ed., 1913), which, though really a reference book, has been the background of the modern teaching of the subject in America. This book, valuable as it is, can not be placed in the hands of beginners, and all teachers will welcome the appearance of the present volume, a book which has been definitely planned to meet the needs of the novice, and which covers, in an elementary way, all branches of the subject.

The introduction of 28 pages is devoted largely to an excellent discussion of fossils and states of preservation. Personally, the reviewer regrets the appearance of the words fossilization and fossilized in this chapter. While these terms may be logically defined, they are seldom logically used, and, once set before a student, no amount of warning will prevent his use of them in a sense implying some alteration of the original substance.

Pages 29 to 82 contain a brief presentation of some of the more important facts concerning fossil plants. It would manifestly be impossible to write, in 55 pages, an introduction to the study of paleobotany, but the author has made a wise choice of the points of more general interest and includes as much as it is possible to use in an ordinary introductory course in paleontology.

The Invertebrata occupy pages 83 to 320. In this part of the book the author follows uniformly the plan of presenting first a somewhat complete description of a typical, if possible, modern, example of each important group, describing the morphology, physiology, and to some extent the habits of the particular animal discussed. Thus, under the protozoa, *Amœba proteus* is described as a type of the phylum, while at the other end of the section, in the phylum Arthropoda, *Cambarus* is described as a type of the class Crustacea, and *Triarthrus* as a type of the subclass Trilobita. Following the description of the type comes a general discussion of the group, relating particularly to those members found as fossils, and finally a brief description of some of the more important genera. Some paleontologists will doubtless criticize the amount of space devoted to the morphology and particularly the physiology of modern forms, but those of us who have to teach know that students rarely come to us with the kind of zoological training which would best fit them to take up paleontology, and to have in one book the zoology and paleontology will be of the utmost use to us.

Pages 321 to 402 contain the description of the Chordata, the cat being taken as a type of the Vertebrata. This part of the book is necessarily, from its briefness, somewhat less technical than the preceding part, but gives a good résumé of the important structural features of the various groups of vertebrates, and of the phylogenies of several families. It is usually found that this part of the subject is of much greater interest to the student and general public than any other part, and it is

to be regretted that the limits of the book did not allow a somewhat more expanded treatment, especially of the Reptilia and Primates.

On pages 403 to 406 one finds a brief bibliography of some of the more important books on subjects treated in the volume, and then follow three pages giving in tabular form the geological time scale and the geological ranges of the principal classes of plants and animals. The remaining 39 pages are devoted to an unusually full index and glossary.

The illustrations in the book deserve special mention. They are very numerous, and an unusually large number are original or redrawn for this work, and all are remarkably clear, well executed, and well reproduced. The figures of the echinoid, pages 167 and 168, may be particularly noted for their delicacy and clearness. Altogether the illustrations are better than those usually found in an elementary text-book.

A very useful feature is the practise throughout the book of giving the derivation of the generic and other group names. The questions, designed to direct laboratory work in connection with the text, will be of more or less value, according to the individual teacher. They serve as a review for the reader and draw attention to the important points in the descriptions. The book is of convenient size, the type good, and though certain paragraphs and the questions are set in another font from the main part of the text, the differences are not so great as to mar the appearance of the page, and are by no means comparable to the "fine print" of a generation ago.

As a text for an introductory course in paleontology the book strikes one as especially well balanced and well done. It will also be found extremely useful to the students of zoology and historical geology, and furnishes us with an answer to the question put so often to a geologist or paleontologist: "Where can I find a book about fossils which I can read without first studying paleontology?"

This review is not meant either as a eulogy or as a criticism of the book in hand, but the writer is aware that the text does contain some small slips, of the kind so peculiarly annoying to the author, but so difficult to detect in proof-reading. Most of these are small things which are either so obvious as to be without danger to the student, or things which would be apparent only to the specialist, and may easily be corrected in a later edition. One which might perplex the beginner is on page 352, where the Urodela are called Lizards. The others are almost all in the explanations of the figures.

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## SPECIAL ARTICLES

### ON THE LIFE OF ANIMALS WITH SUPPRESSED KIDNEY FUNCTION

Both clinical and laboratory observations agree in demonstrating that many of the so-called consequences of kidney disease are really nothing of the kind, but must be interpreted in some other fashion. Thus, the assumption that the edema sometimes found in patients suffering from kidney disease is the consequence of the disturbed kidney function lacks all support, for patients with complete suppression, or animals from which both kidneys are removed, do not show any consequent edema. In fact, such patients and animals steadily *lose* in weight unless special efforts are made to keep this up. Large, nephrectomized rabbits, for example, will lose some 50 grams per day before they succumb some four to eight days later.

In the same way that clinical experience and experiment have shown that the edema accompanying certain kidney disturbances is not to be regarded as a consequence of the loss of kidney function, they prove also that high blood pressure, cardiac hypertrophy, and the clinical manifestations of headache, stupor, coma, etc., so commonly regarded as "uremic" are not secondary to such loss of kidney function as so widely believed. The fact remains, however, that even though much revision is necessary in our interpretation of the signs and symptoms evidenced by victims of kidney disease, loss of kidney function is commonly regarded as incompatible with any prolonged continuance of life.

Why does man or an animal deprived of his

kidney function die? Since nephrectomized animals regularly show a progressive loss in weight, and since this is, in the main, only water, a first reason for death might reside in the gradual drying-out of the tissues. Whether the animal is fed or whether it is starved, a certain minimum of necessary chemical changes goes on, which continue, as long as the animal remains alive. A second reason for the death of the kidneyless animal resides, therefore, in the accumulation of metabolic products within the organism which normally are thrown off in the urine. A third reason for death (but one for which at present we lack every experimental proof) might reside in the loss of some internal secretion produced by the kidney and necessary for life of the organism as a whole.

The analysis of the conditions necessary for a proper exhibition of kidney activity would seem to indicate that it is the primary function of the kidney to secrete water. It secretes water in proportion to the amount brought it in a free state in the arterial blood stream. As this free water passes down the uriniferous tubules it leaches out of the cells bordering it and constituting the kidney parenchyma the dissolved substances which give urine its distinguishing characteristics (urea, ammonia, creatin, sugar, salts, etc.) which substances originally diffused into the kidney parenchyma from the blood stream.

If we ignore the matter of an internal secretion, these considerations, if correct, compel the conclusion that the kidney is of importance to the animal, first, because it is an organ through which water may be lost when present in amounts over and above those necessary to saturate the tissues (saturate the hydrophilic colloids); and second, because this loss of water makes possible the loss of certain dissolved substances which appear in even normal metabolism.

The steady loss of water in the ill or by a nephrectomized rabbit, for example, need not, of course, be an important element in the causation of death. Care in the administration of water by rectum or subcutaneously can overcome this. Nor is the inability to lose much water quickly, as by the kidney route, alone an insurmountable cause for death. Even under physiological conditions the human being not only can but does lose more water from the lungs and skin than through the kidneys. What is missing is the possibility of losing along with the water the various dissolved substances which appear as the products of metabolism. If this reasoning is sound it is to be expected that, other things being equal, *animals deprived of their kidney function should live the longer the better the possibilities of securing an adequate loss of dissolved substances along with their water elimination.* The facts bear this out. The furred animals, for example, which lose no water except through the lungs, after the kidneys are removed, survive this operation little more than four to eight days. The human species with its ability to sweat tolerates loss of kidney function some six to twelve days. James Taggart Priestley has reported the case of a patient who lived 22 days with complete suppression of urine. It is considerations of this kind that have prompted clinical workers to resort to sweating and catharsis by way of transferring to the skin and gastro-intestinal tract the functions which are ordinarily subserved by the kidney whenever this organ is pathologically affected. But even when advantage has been taken of such potentialities, the lives of patients with complete loss of urinary function have not been long.

It occurred to me that it ought to be possible to observe a greater span of life in animals after complete suppression of kidney function if only it were possible on the one hand to cover the needs for water absorption and water loss, while on the other, provision were made for an adequate loss of the products of metabolism which normally are leached out by the water which passes through the kidney.

Such conditions are satisfied in the case of the frog. Not only does the frog cover its daily needs for water (saturate its body colloids) by spending a part of its time in the water, but it also loses under the same circumstances the same group of materials which ordinarily give the urine its characteristic composition. The problem is similar to that in man, who loses the same dissolved substances in the sweat that

he loses in the urine, only in less amount. The frog does the whole more easily. When sitting in the water it not only absorbs water to supply its needs, but loses at the same time the non-volatile products of its daily metabolism (these diffuse into the water from the skin exactly as the same substances in the mammal diffuse from the kidney cells into the water running down the uriniferous tubules). As I have so frequently insisted, solutions are not absorbed or secretions given off "as such." While a secretion of water and of dissolved substances may occur in the same direction, they may quite as easily take opposite ones. These considerations make it apparent why on *a priori* grounds alone *the frog (and other amphibia) should be able to tolerate a loss of kidney function better than land animals.*

*Experiment has justified the conclusion.* I tried originally to bring proof in this direction by cutting the kidneys out of frogs. The operation is not only difficult, but fails because of the anatomical peculiarities which characterize the circulation in these animals. Since the venous blood returning from the legs passes through the kidneys, their excision is followed by an edema of the hind legs. To escape this effect and yet to exclude the external function of the kidneys, the ureters were therefore tied. Under aseptic precautions a series of frogs were operated upon through the flanks and the ureters isolated. They were tied with a first ligature close to the kidney and with a second as near the bladder as possible, the connecting segment of ureter being cut out. *These animals have now lived since January 8 of this year and are perfectly normal.*

My technical assistant, Josef Kupka, showed me how to keep these animals in excellent condition. They are housed in glass boxes heavily padded with moist moss. Inverted porcelain dishes with side openings permit them to hide. A shallow enamel pan always filled with fresh water is placed at one end of each cage. Every few days the frogs are fed live meal worms, which they devour ravenously. The wounds heal completely two weeks after the operation. At the present writing the animals thus operated are livelier and in better physical condition than the winter frogs comprising the stock from which they were chosen.

The kidneys of the frog after ureteral ligation seem to suffer but slight if any change. What has been observed will be discussed at another time.

These experiments prove that *frogs may live for weeks after complete suppression of external kidney function.* If the explanation of why this is possible in the frog is accepted as correct, it not only gives scientific support to long-established empirical clinical practises, but emphasizes the importance of a closer analysis of the conditions which may improve qualitatively or quantitatively the matter of absorption and secretion of water and absorption and secretion of food and the products of metabolism through the skin and bowel in the patient suffering from an inadequate kidney function.

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## *SOCIETIES AND ACADEMIES*

### THE CHICAGO ACADEMY OF SCIENCES

THE annual meeting of the Chicago Academy of Sciences, held January 12 at the Academy building in Lincoln Park, Chicago, was an occasion of special interest. The chief speaker was Dr. Albert A. Michelson, of the University of Chicago, who presented in simple, untechnical language the results of his remarkable studies on the rigidity of the earth. Dr. T. C. Chamberlin reviewed the history of the academy during the past eighteen years, during which time he had been president, and the following officers for the coming year were elected:

Professor John M. Coulter, President.
Professor Henry Crew, First Vice-president.
Dr. Stuart Weller, Second Vice-president.
Dr. Wallace W. Atwood, Secretary.
Mr. Henry S. Henschen, Treasurer.

Mr. LaVerne Noyes, president of the board of trustees, spoke encouragingly of the present and future work in the museum. Mr. Noyes is especially interested in the construction of habitat groups illustrating the natural history of Chicago and vicinity, and through his personal supervision and generosity a remarkable series of forty-one new groups was opened for inspection at the close of the business meeting. Dr. Wallace W. Atwood, of Harvard University, who has held the secretaryship of the academy during the last few years, and been associated with the academy boards in the or-

ganization of the museum and in the promotion of educational work, returned to Chicago to address this meeting on the "Progress of the Museum Work during the Past Year."

The "Celestial Sphere," which was recently installed in the Academy building, was open for inspection, and demonstrations were given at frequent intervals. In this apparatus all of the brighter stars which are ever visible from the Chicago region are represented in their appropriate places and with their appropriate magnitudes. By electrical power the sphere is rotated, so that the stars follow precisely similar courses to the apparent motion of the fixed stars in the heavens. In eleven and one half minutes the sphere completes one rotation.

The policy of the museum during the past few years has been to limit its new exhibits to those illustrating the natural history of the Chicago region. Thus the birds, mammals, insects, reptiles and flowers of Chicago and vicinity have been placed on exhibition. Every pains is taken and no expense spared to make these exhibits of the local material just as attractive as any that could be prepared. Each exhibit is arranged to bring out some feature in the life of the animal rather than to display the mounted specimen as dead. Each habitat group is based on field studies; the background is an enlarged and colored photograph taken in the field where the specimens were collected, and the foreground is so constructed that it blends imperceptibly into the painted background. The animals are either at play, in search of food, quarreling, caring for the young, or in course of flight. These exhibits have already proved to be of unusual educational value to the community, and they are being used regularly by the teachers in the public and private schools of Chicago.

The children's science library and free reading room was opened for inspection. About three hundred members and guests were present.

On the evening of January 15, the board of trustees gave a dinner in honor of LaVerne Noyes. This dinner was given as an expression of the hearty good fellowship in the board, and of the sincere appreciation of the generosity of Mr. Noyes in promoting the work of the academy. Mr. Henry S. Henschen presided as toastmaster. Professor T. C. Chamberlin, Professor John M. Coulter, Dr. Frances Dickinson and Dr. Wallace W. Atwood responded to toasts. At the close of the dinner the toastmaster presented a loving cup to Mr. Noyes on behalf of the board of trustees.

### THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 537th meeting of the society was held in the Assembly Hall of the Cosmos Club, Saturday, March 6, 1915, called to order by ex-President Stejneger at 8 P.M., with 60 persons present.

Under the heading Brief Notes, Professor A. S. Hitchcock called attention to the plans and methods of work in preparing a new Flora of the District of Columbia. It is hoped it will be completed within a year. It will contain analytical keys of all the higher plants found within a radius of fifteen miles of the city of Washington. It will not contain descriptions.

The first paper of the regular program was by J. W. Gidley, "Notes on the Possible Origin of the Bears." After the examination of much fossil and living material the speaker had arrived at the conclusion that the bears, constituting a small homogeneous, widely distributed group are not closely related to other living Carnivores. From a consideration of the tooth structure, the bones of the feet, and the basal cranial foramina, Mr. Gidley concluded that the bears were probably derived from the *Clænodon* group of the Creodonts, and that other living Carnivores were descended in part at least from the Miacidæ, a family of Creodonts not distantly related to the *Clænodon* group.

The second communication was by the sculptor, H. K. Bush-Brown, "The Evolution of the Horse." The speaker was present by special invitation of the president and introduced to the society by ex-President Stejneger. Mr. Bush-Brown discussed briefly the geological evolution of the horse, and then spoke at considerable length on the evolution of modern breeds of horses, particularly of he Arab and the effects of breeding it with other races, and its development in this country. His paper was well illustrated by lantern slides showing anatomical characteristics of various horses, as well as their external appearances.

On Thursday, March 11, 1915, at 8:30 P.M. the Biological Society of Washington held a joint meeting with the Washington Academy of Sciences in the Auditorium of the National Museum. Mr. Wilfred H. Osgood, of the Field Museum of Natural History and a member of the special commission for investigating the fur-seal question for the Department of Commerce during the summer of 1914, delivered a lecture illustrated by stereopticon and motion pictures on the fur seals and other animals of the Pribiloff Islands. All phases of the life of the seals on the islands, methods of killing, skinning, salting, etc., and

the introduced herds of reindeer, the Steller's sea-lions, and the native birds were shown in motion. About 350 persons were present.

M. W. Lyon, Jr.,
*Recording Secretary*

ANTHROPOLOGICAL SOCIETY OF WASHINGTON

At the 478th meeting of the society held December 1, 1914, in the Public Library, Dr. George S. Duncan delivered an address on "The Sumerian People and their Inscriptions." Their oldest inscriptions antedate 3,000 B.C., and the Enlil temple in Nippur dates back probably to 6,000 B.C. The Semites from Arabia conquered the Sumerians before 2,100 B.C. Of the Sumerian cities, only Lagash and Nippur have been thoroughly excavated. Scholars agree that the Sumerians were neither Semites nor Indo-Europeans, but were probably Mongolians. Their language was agglutinative. Their only garment was a rough woolen skirt. Various cereals were grown; also the date palm. There were many occupations, including weavers, smiths, boat-builders, jewelers and carvers in wood and ivory. There were priests, librarians, notaries, physicians, astronomers and musicians. The country was divided into city states ruled by kings. The age of Gudea, about 2,600 B.C., was one of high artistic development. The chief divinities were Anu, god of the sky, Enlil, god of the earth, and Enki, god of the water. Their religion was nature worship. The inscriptions consist mainly of historical records, laws, contracts, epics and religious texts. The tablets contain the oldest records of a paradise, a fall and a flood.

At the 480th meeting of the society, held January 5, 1915, in the Public Library, Dr. John R. Swanton read a paper on "Ethnologic Factors in International Competition." He showed that the factors which tend to disunion between human societies have been operative in all parts of the world and were probably necessary to the best development of the race. At the same time, the end of warfare may be confidently predicted from the constant increase in size and decrease in number of political units, from the progressive weaving of the world more closely together by means of transportation facilities and other means of communication, and because of the gradual international bankruptcy which war entails. A standing army goes with an aristocratic ruling class. There can be no permanent peace until exploitation of one nation or class by another ends.

At the 481st meeting of the society, held January 19, 1915, Prince Sarath Ghosh delivered an address on "The Ancient Civilization of India." The Aryans settled in India between 6,000 and 4,000 B.C. and there adopted agriculture, the beginning of civilization. Here also man passed from promiscuity to monogamy. The government was first patriarchal, then a republic, then an oligarchy, then a monarchy. With the latter began the caste system. Man first worshipped tools and weapons; later, nature. By 2,500 B.C. the Hindus worshipped a supreme deity and the language in the Vedas had reached its highest perfection. Deity was regarded in its gentler qualities as feminine. With religion began the arts and sciences. The age of life on the earth was estimated at four million years. An exalted code of warfare was evolved. By 600 B.C. Hindu civilization had reached its zenith. The Aryan invaders conquered the Turanian or Dravidian races they found in India and made of them subordinate castes. India taught the arts and religion from Java to Japan.

Daniel Folkmar,
*Secretary*

ACADEMY OF SCIENCE OF ST. LOUIS

At the meeting of March 15, Professor Nipher gave a brief account of work done in his laboratory. During the summer of 1914 he detected what appeared to be an effect of the fog-horn of a steamer on the magnetic field of the earth.[1] In his recent work a large bar magnet in a room containing an influence machine, and in contact with one terminal, served as a deflecting magnet upon a magnetic needle in an adjoining room. The deflecting effect of this magnet was balanced by another bar magnet, on the opposite side of the needle. The needle was made very sensitive by means of compensating magnets. A musical note from an organ pipe, operated by means of compressed air, produces effects precisely like those attributed to the fog-horn. Here also the effect is superposed on disturbances of the same order of magnitude due to other causes. Professor Nipher remarked that any disturbance of ionized air appears to be the origin of electro-magnetic waves in the ether. When we talk to each other in air ionized by solar radiation, we are perhaps sending wireless messages through the ether of space.

C. H. Danforth,
*Recording Secretary*

[1] Science, January 15, 1915.